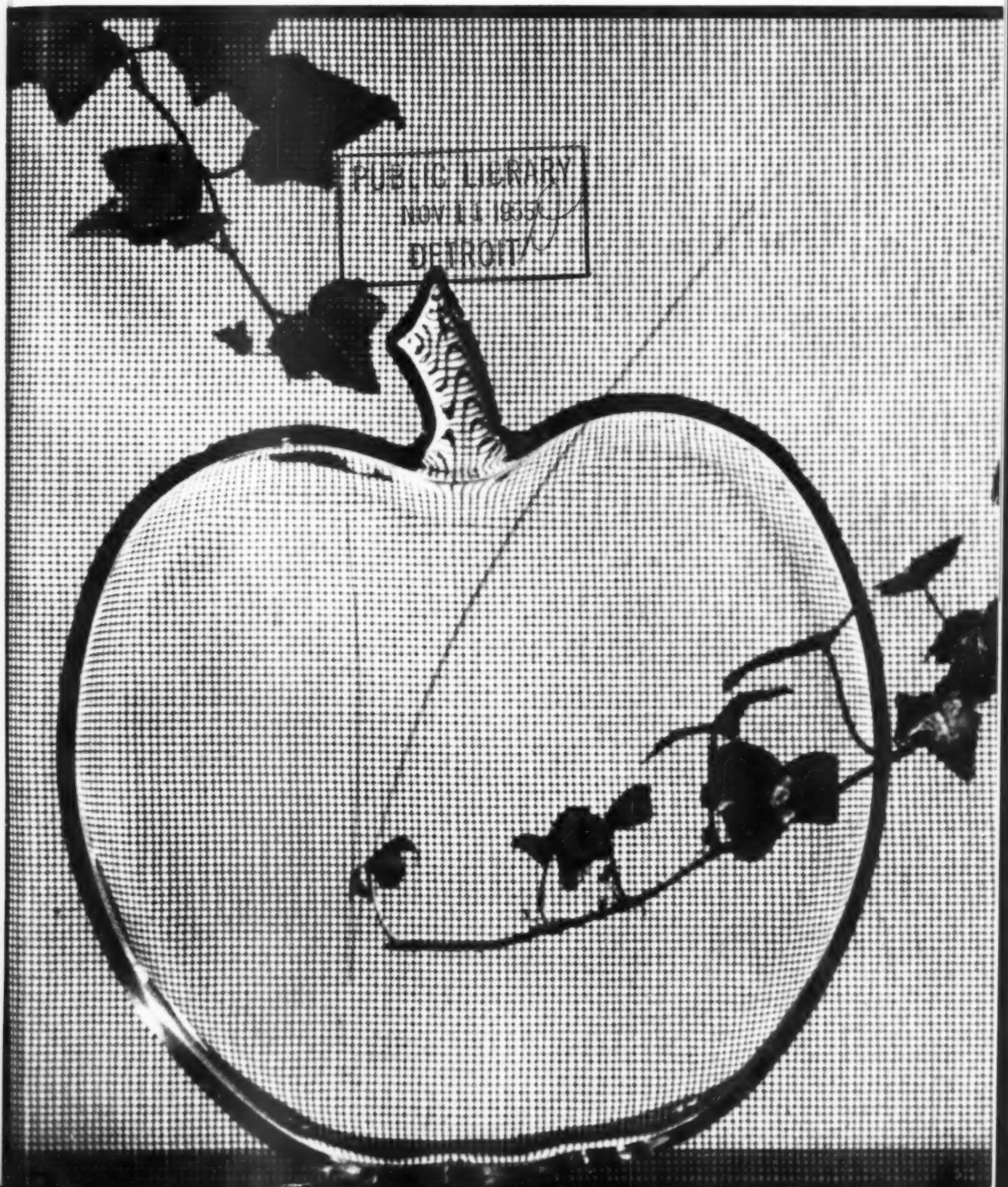
TECHNOLOGY DEPT.

TECHNOLOGY REVIEW

November 1955



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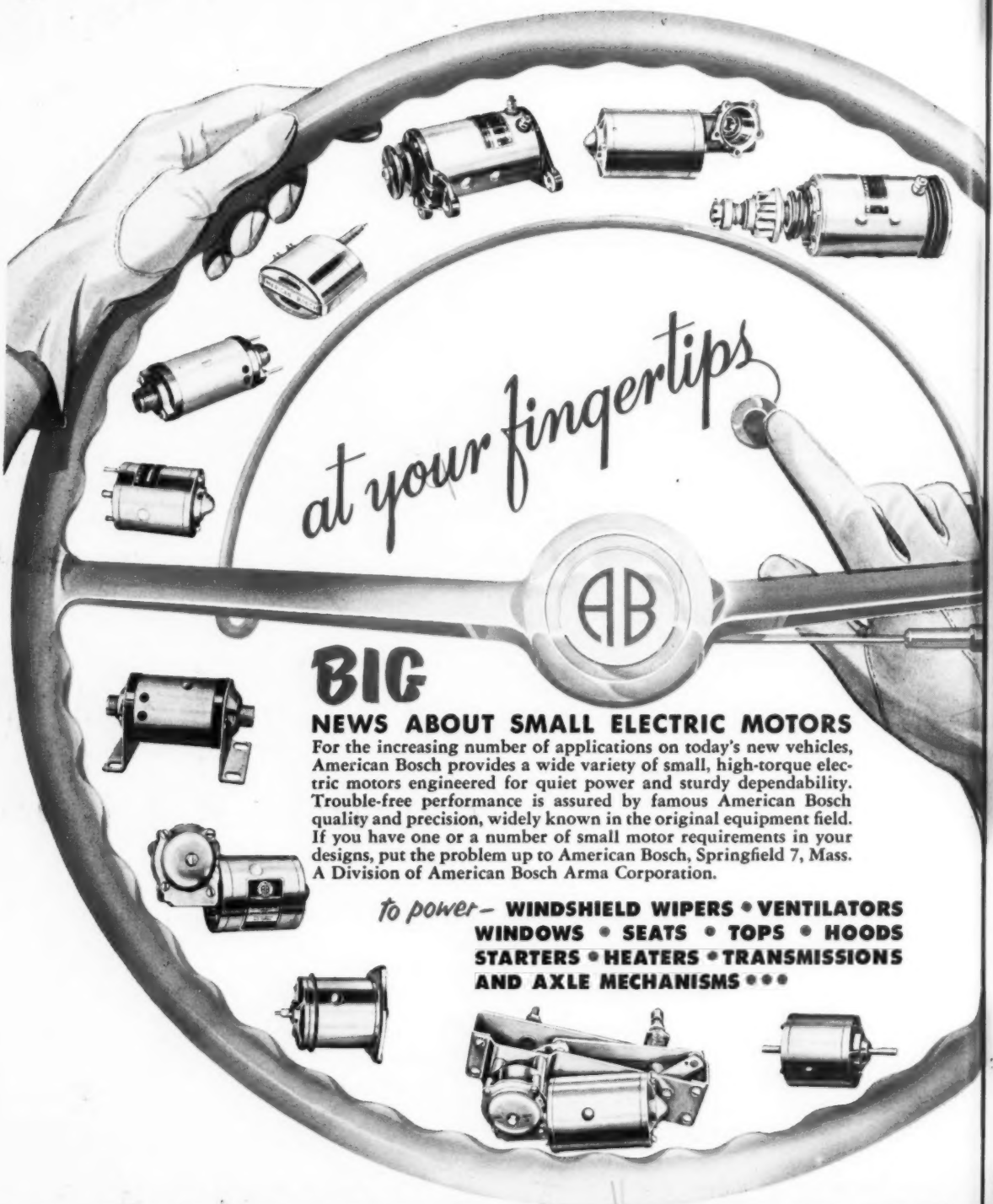

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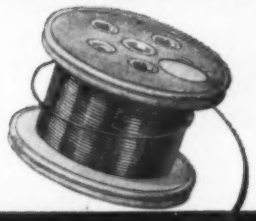

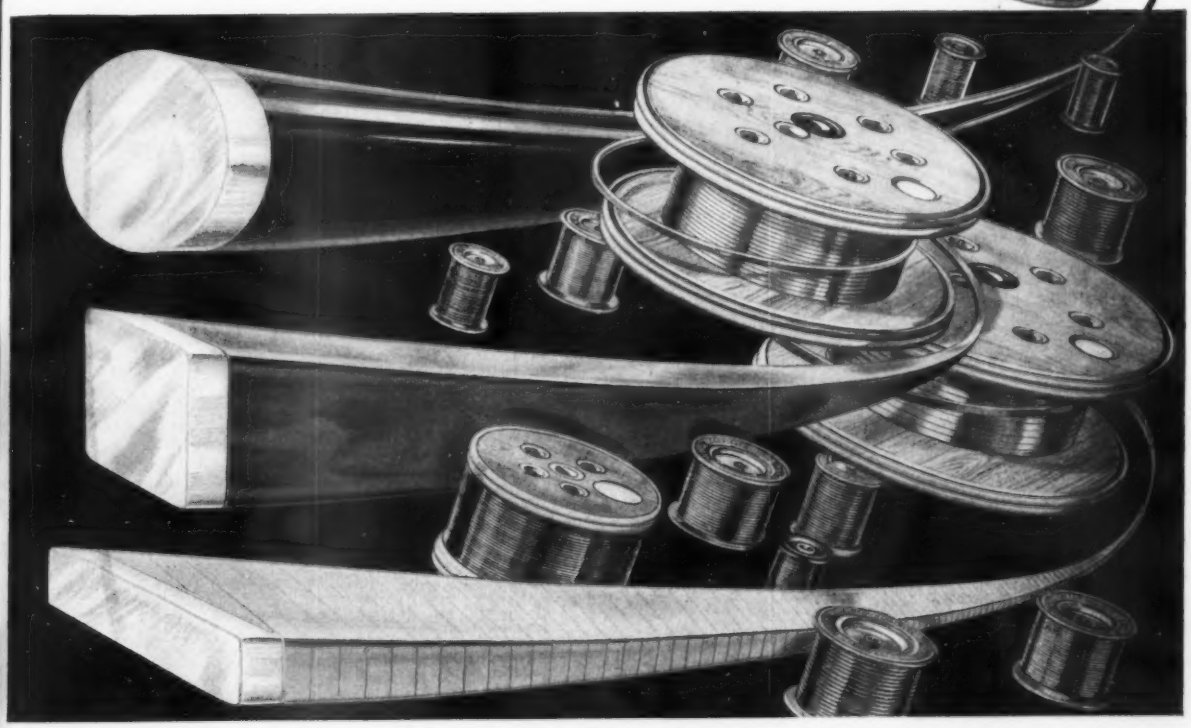

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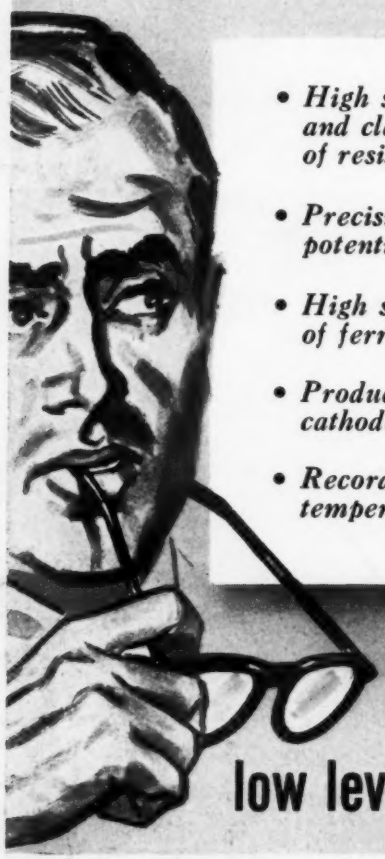

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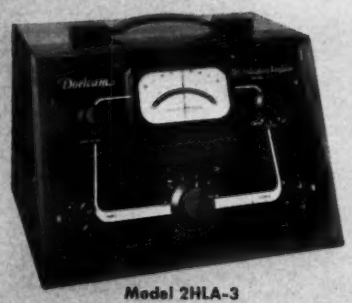

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THE TABULAR VIEW

Atomic Energy Impact. – Our article "The Impact of Atomic Energy on the Physical and Chemical Sciences" (page 15) is a report on an Alumni Day address by JOHN VON NEUMANN, Commissioner of the Atomic Energy Commission. Educated at Berlin University, Zurich Technische Hochschule, and the University of Budapest (where he received the Ph.D. degree in 1925), Dr. von Neumann became visiting professor in mathematical physics at Princeton University in 1930. He was later professor at the Institute for Advanced Study at Princeton, and consultant and member of various scientific boards and commissions for the United States government.

Weather by Radar. – "Radar and the Weather" (page 18) by PROFESSOR HENRY G. HOUGHTON, '27, is one of the papers presented by a Faculty member to the 350 persons who attended the Alumni Officers' Conference at M.I.T. on September 9 and 10. Professor Houghton received the B.S. degree from Drexel Institute in 1926, the S.M. from M.I.T. in 1927, and the D.Sc. degree from Drexel in 1947. He conducted research at Round Hill, South Dartmouth, Mass., from 1928 to 1938; became assistant professor, 1939; associate professor, 1942; and since 1945, professor and head of the Department of Meteorology. Dr. Houghton's principal studies have been of fog, clouds, precipitation, and atmospheric radiation.

Conference. – The Editorial Staff of The Review is proud to present (page 22) its 18,000-word report on the Alumni Officers' Conference, held at M.I.T. on September 9 and 10. This is the most detailed and complete report on M.I.T. activities to appear in The Review during the last 25 years and follows in quick succession the Review-prepared copy of 18 pages on the Kresge Auditorium (June, 1955) and 14 pages on Alumni Day and commencement (July, 1955).

(*Concluded on page 6*)

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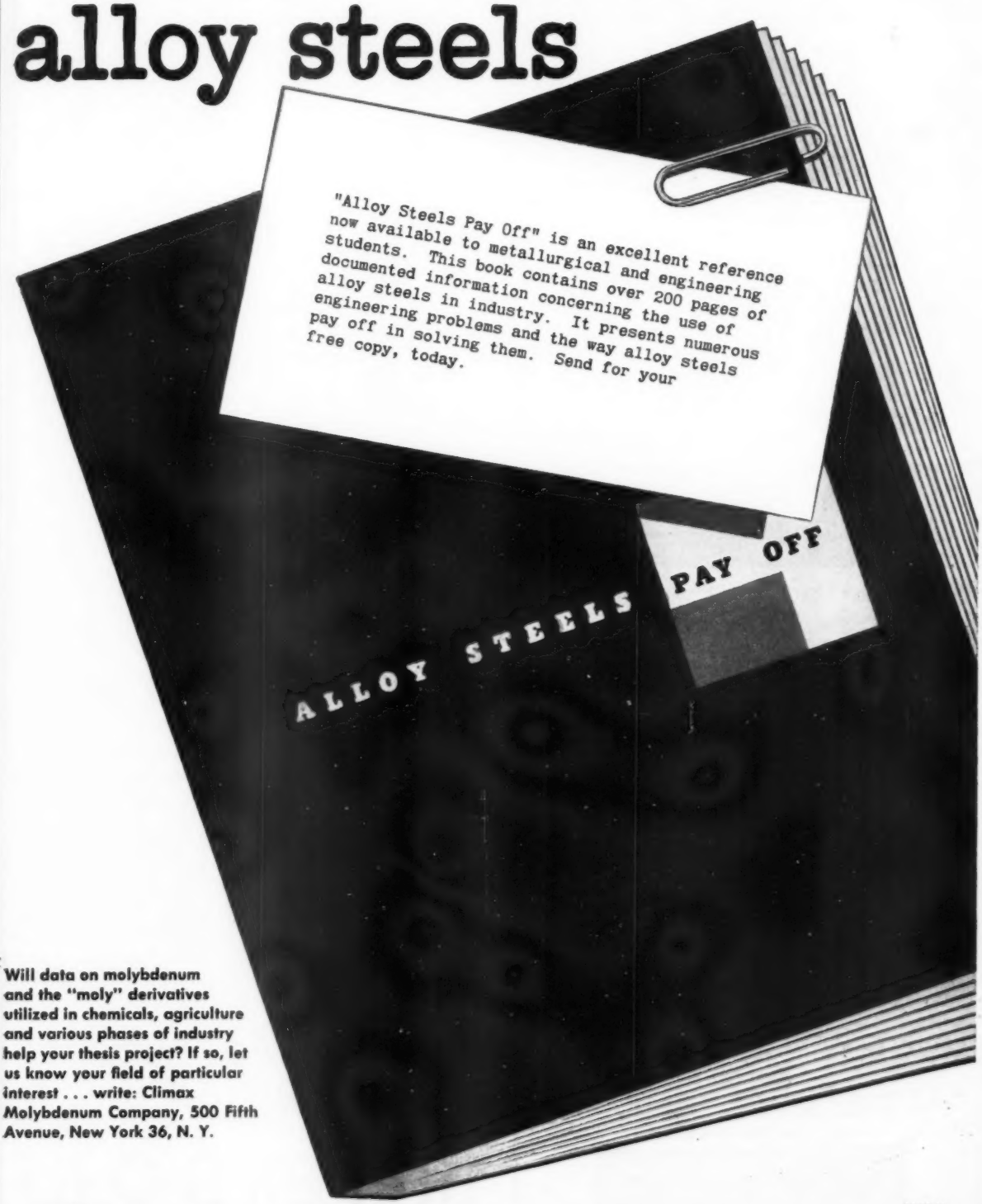
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THE TABULAR VIEW

(Concluded from page 4)

Student Government. — A student's point of view is presented (page 31) in "An Evaluation of Student Government" by JOHN S. SALOMA, 3D. Mr. Saloma, a senior at the Institute, is pursuing the Course in Business and Engineering Administration and plans to do graduate work in this field. He is a member of Tau Beta Pi, Scabbard and Blade, and DeMolay, and president of the Institute Committee. His Review article was originally presented before the Alumni Officers' Conference.

Man-Power Resources. — Always stimulating is the annual message of PRESIDENT JAMES R. KILLIAN, JR., '26, to the M.I.T. Corporation. In this year's President's Report (page 33), Dr. Killian outlines the nation's current man-power needs, and clearly defines the Institute's goal for producing superior graduates as one means of helping to fill this need. To a long and distinguished career as editor, and administrator, President Killian has recently concluded another brilliant chapter as public servant, as chairman of a committee, appointed by President Eisenhower, to study the nation's defense program. President Killian has also been named chairman of a committee for planning Atoms for Peace Awards.

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ISOTOPES are being used in similar fashion by industry and agriculture to analyze materials, measure wear, control processes, and to help answer mysteries of how plants absorb nourishment from the soil and how it affects their growth and health.

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Who's to pay the cost of education?

"WHATEVER the plan, there must be more support per person and per corporation. We'll all just have to dig a little deeper. In recent years, our bill for organized education in all categories has been running at less than 4% of the Gross National Product. With predicted growth in our national output, if we can increase only a little the percentage spent on education, our needs will be met.

"Under the Corporate Alumnus Program, the General Electric Educational and Charitable Fund matches up to $1,000 donated by employees to their alma maters. This concept is based upon the belief that the individual decisions of thousands will form a sound basis for widespread support of education ... The responsibility of the alumni group is, I believe, to sell the idea that in a free economy in the long run it is desirable that the real cost of education be borne by the individual who gets the education and benefits from it."*

— PHILIP D. REED,
Chairman of the Board of Directors, General Electric Company

How far can our aid to education go?

"THIS approach (Corporate Alumnus Program) is only a start. But it is rooted in the recognition that you and I can't longer continue to run a progressive and productive school system on a charity basis. I will answer the question as to who should pay for a college education by offering the cold-nosed conclusion that in a free economy in the long run it both should be, and rightfully can be, the man who gets the education; and that should be made clear to him the day he *starts* to get it.

"Of course, we also favor business support, for business draws many of its ablest profit-making human resources from your institutions. We must examine such support, however, instance by instance, and never let it slide into any license to dictate policy or to restrict academic activities ably conceived by courageous and level-headed educators who are truly alert to both the challenges and the opportunities of the economy and the society in which they live."*

— HAROLD F. SMIDDY,
Vice President, Management Consultation Services, General Electric

What obligation does an alumnus have?

"IS it such a revolutionary idea that the real cost of education be borne by the individual who gets that education and benefits from it? Not necessarily across the barrel head, not necessarily all at once, and not necessarily even under certain sets of circumstances. But I submit that it is an unhealthy idea for an individual to expect society to pay his education bill, any more than to expect society to pay for his food, clothing, shelter, hospitalization, vacations, and ultimately for the education of his children and grandchildren, too.

"One of the first things that business babes in the education woods learned was that practically nobody pays the real cost of his education. One reason is that he is never asked to pay it. We have acknowledged that the organization of which an individual is a part shares the benefits, and we are willing to help pay the bill — but this is a joint undertaking."*

— KENNETH G. PATRICK,
Manager, Educational Relations, General Electric

***For free copies** *of any of the complete talks from which these remarks were taken, write to Educational Relations, Dept. 2-119, General Electric Company, Schenectady, New York.*

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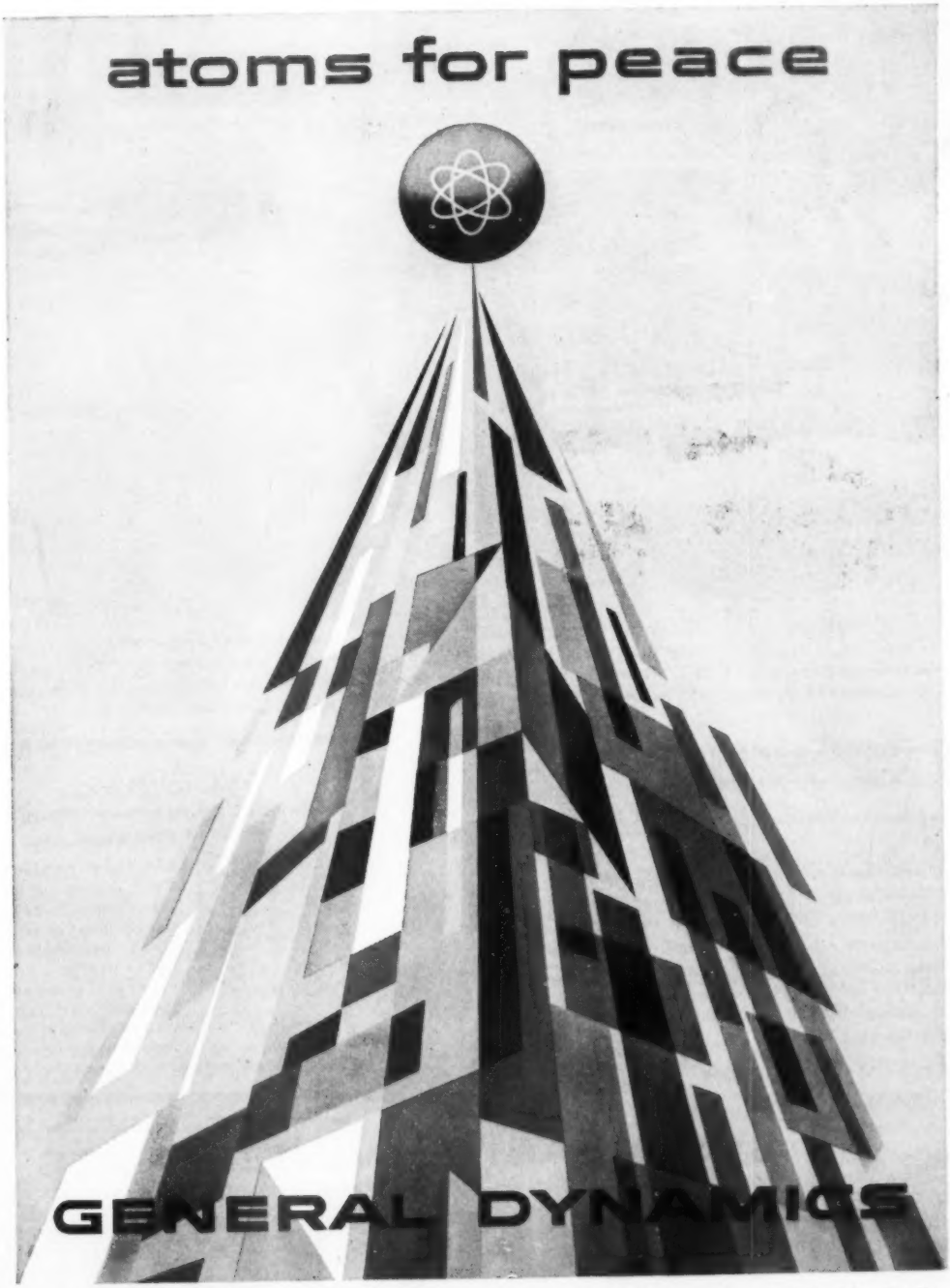

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VOL. 58, NO. 1 NOVEMBER, 1955

CONTENTS

EDEN'S FRUIT
PHOTOGRAPH BY LEWIS T. REED, A.P.S.A., A.R.P.S. ..... THE COVER

FALL SCENE AT LANCASTER, MASS.
PHOTOGRAPH BY RAYMOND E. HANSON ..... FRONTISPIECE 12

IMPACT OF ATOMIC ENERGY ON THE PHYSICAL AND CHEMICAL SCIENCES ..... BY JOHN VON NEUMANN 15
In the long run, the indirect effects of the study of nuclear science may be more significant than those which have already influenced our way of life

RADAR AND THE WEATHER ..... BY HENRY G. HOUGHTON 18
Microwave electronic detection methods, developed during World War II, enable meteorologists to improve their understanding of tornadoes, hurricanes, and rainstorms

ALUMNI OFFICERS' CONFERENCE 22
Class Officers, Honorary Secretaries, and Educational Counselors gather at M.I.T., September 9 and 10, for a two-day work session in studying Institute problems

AN EVALUATION OF STUDENT GOVERNMENT
BY JOHN S. SALOMA 3D 31
President of the Institute Committee surveys student participation in governing collegiate activities in a report before the Alumni Officers' Conference

OUR MAN POWER RESOURCES ..... BY JAMES R. KILLIAN, JR. 33
President Killian's annual report to the Corporation stresses the Institute's obligation to train outstanding leaders to meet the needs of our modern technological society

THE TABULAR VIEW • *Contributors and Contributions* 4

THE TREND OF AFFAIRS • *News of Science and Engineering* 13

THE INSTITUTE GAZETTE • *Relating to the Massachusetts Institute of Technology* 35

Raymond E. Hanson

New England Charm

Autumn foliage enhances the traditional architecture of this house in Lancaster.

THE

TECHNOLOGY REVIEW

Vol. 58, No. 1 November, 1955

The Trend of Affairs

Brand Loyalty

MANUFACTURERS of consumer products devote a great deal of effort to the marketing of their products in accordance with high standards of quality and uniformity. They also expend much effort in attempts to identify their products, in the minds of actual or potential customers, by means of brand designations.

As one means of enhancing profits, it is not surprising, therefore, that marketing executives would like to see an increase in the proportion of families whose purchases are customarily made on the basis of brand loyalty, or that they would like to see a decrease in that segment of consumers whose purchases reflect little or no brand preferences. The methods by which this marketing objective might be achieved are by no means clear. Indeed, it is not even definitely known whether brand loyalty is primarily a characteristic of the personal habits and preferences of the purchaser, or whether the type of commodity sold or the merchandising technique employed is the major factor in brand selection.

Because very little has been published on this broad general topic, a program of research on brand loyalty has been conducted by Ross M. Cunningham, Associate Professor of Marketing, with the support of the Sloan Research Fund of the Institute's School of Industrial Management and the co-operation of the Chicago *Tribune's* purchase panel. At the beginning of the project he was assisted by Donald R. Sohn, then instructor in Marketing, and more recently by Roger K. Olen, '55, and Charles Y. Chittick, Jr., '50, research assistants. Stimulated in part, by the important work of George H. Brown, this program investigates new aspects of brand loyalty and new methods of measurement.

One major objective of this study is to determine whether there are families (in sufficient numbers as to be significant to marketing executives) who are inclined toward brand loyalty, regardless of products purchased; and whether there are also significant numbers who are disinclined to favor product brands.

This study is believed to be the first investigation of loyalty-proneness, or the persistence of brand loyalty in individual families, in purchasing a number of different types of products. It provides new information on consumer buying behavior and develops a necessary foundation for field research into the characteristics of families favorable and unfavorable to brand loyalty. Available socioeconomic data on the families studied have been analyzed, but this does not explain their buying behavior. By means of later field investigations of the families identified in this study, it is hoped that general methods may be found for locating brand-loyal families and for developing effective techniques for appealing to this type of group for the purchase of specific brands of commodities.

Purchase records, based on weekly reports from 650 families in the Chicago *Tribune* purchase panel, during the years 1950, 1951, and 1952 contributed the major source of information used in this study. Seven different frequently used household products are studied: coffee, canned peas, oleomargarine, frozen orange concentrate, toilet soap, scouring cleansers, and headache remedies. For each purchase, the records give the date, brand, size of package, number of units, price, and store where purchase was made. With such data at hand, the first step was to identify a group of 402 families who had reported continuously over the three-year period. Then minimum thresholds were set for each commodity and families buying less than these amounts were excluded from the analysis.

Brand loyalty for each family has been measured by computing the per cent of total three-year purchases for each commodity on four bases: (1) percentage represented by the largest single brand; (2)

percentage represented by the two largest brands; (3) percentage represented by consumption of the largest single brand after deducting purchases on special "deals"; and (4) percentage represented by consumption of the two largest brands after deducting purchases on special "deals." Various analyses have been made of the families buying each product, using these four measures of brand loyalty. In some analyses, these measures have been expressed as ranks and in others as absolute numbers.

The basic validity of these brand loyalty measurements has been proved by analyses of the values which would be found under conditions of random purchase, taking into account both the number of brands typically available and the store-purchasing habits of the families.

In order to measure the existence and extent of loyalty-proneness, it has been necessary to identify static samples of families purchasing groups of products in amounts greater than threshold quantities. There are 244 families who purchased coffee, canned peas, toilet soaps, and scouring cleansers over the three-year period, and 66 families who purchased all seven products mentioned previously. These have been analyzed statistically.

In addition to the main elements in the investigation, other aspects of the problem have been studied. These include an examination of the relationships between brand loyalty and store loyalty; between brand loyalty and proportion of purchases made on special price inducements; between the several socioeconomic factors available on the panel families and their brand loyalty performance; between time patterns in purchasing and brand loyalty; between rate of acceptance on new brands and brand loyalty; and a number of other aspects.

Some tentative conclusions may be stated. The upper ranges of brand loyalty appear to run higher than would be expected from the literature and opinions of many marketing people. There are differences between products, with headache remedies and scouring cleansers measuring higher than coffee and frozen orange concentrates, while toilet soaps and canned peas are lower. However, the single brand loyalty of the top 10 per cent of the 66 seven-product families averaged over 90 per cent for all products except the two lowest – toilet soaps and canned peas – for which it was 84 per cent. The bottom 10 per cent of the families had percentages between 20 and 33. There is a limited tendency toward loyalty-prone behavior. There is a meaningful inverse correlation between brand loyalty and families who purchase heavily on "deals."

High Steaks

A JUICIER, tenderer steak can usually be found in certain restaurants than on any home dining table, even when the best meat available in retail butcher shops is purchased for serving at home. It is true that ordinarily the finest meat is all taken up by restaurants and hotels, and never reaches retail food stores. But it also is true that eating places specializing in steaks generally age the meat, for the purpose of enhancing tenderness, considerably longer than does the retail butcher. Indeed so-called "steak house" restaurants sometimes have refrigerators built into their show windows, displaying great quantities of beef undergoing extended aging. Such aging is costly, not only because of the expense of the necessary refrigeration facilities, but also because long aging causes surface discoloration and deterioration, that necessitates trimming off and discarding substantial amounts of meat.

When an animal is slaughtered for meat, the muscles soon go into *rigor mortis*, becoming rigid. Then a slow, gradual softening of the meat ensues. Aging of meat for tenderizing merely involves holding it until this spontaneous softening process is well advanced. Originally, it was thought that softening during storage was due to proteolysis or liquefaction (essentially putrefaction) of the tough connective tissue present throughout all meat. But recent exhaustive chemical studies of meat from a large number of animals, stored for various periods of time, indicate that this is not true. No changes in connective tissue were found even after prolonged storage.

Increasing tenderness was, however, correlated with changes of two types observed in muscle tissue. One of these changes was shifting interrelationships of two muscle plasma proteins, called *myosin* and *actin*. In living muscle, these two proteins apparently are separate, and in such form are soft and readily extensible. When *rigor mortis* develops, actin and myosin are thought to unite into a substance called *actomyosin*. This protein is inextensible, and accounts for the rigidity of muscle in *rigor mortis*. During aging, actomyosin apparently slowly dissociates into actin and myosin, thus restoring softness.

The studies cited also obtained presumptive evidence that metallic ions, such as potassium, migrate from one muscle protein to another during aging, and in doing so may enhance the hydration or moistness (hence tenderness) of the meat.

Other recent research, on storage of beef, measured effects of air temperature, air speed, and relative humidity on drying and discoloration of the meat. Recommendations for optimal storage conditions, to minimize wastage from necessary surface trimming, resulted.

Studies such as those just summarized have practical implications for devotees of tender steaks. Once the actual mechanisms of meat tenderizing during aging are fully known, perhaps the changes involved may be brought about by accelerated methods, thus reducing costs. For example, if ion migration is the answer, such migration might be forced by infusion (pumping solutions into the blood vessels) of freshly slaughtered animals. Some work has indeed been done along these lines. If, on the other hand, prolonged aging remains the best tenderizer, information on optimal storage conditions, to minimize losses by surface spoilage, should reduce ultimate cost to the consumer. Perhaps a day will come when those of slender means who desire tender steaks will not find themselves limited to hamburgers. In fact, the plebeian hamburger is no longer only for those of limited income. The "Do-It-Yourself" era which has popularized the backyard cook-out is creating fair competition between hamburgers and steaks.

Impact of Atomic Energy on the Physical and Chemical Sciences

In the Long Run, the By-Products of Nuclear Science May Be More Important to the Physical Sciences Than the Direct Result of Initiating New Sources of Energy

By JOHN VON NEUMANN

In opening the Alumni Day symposium (June 13, 1955) on the topic of "The Impact of Atomic Energy on the Physical and Chemical Sciences," Dr. von Neumann spoke extemporaneously, without benefit of prepared manuscript or extensive notes. The following article is a summary which reflects the essence of the address.

In examining the impact of atomic energy on the physical and chemical sciences, it is well to begin by asking a few pertinent questions. For example, we may ask ourselves, "What situation are we in as a result of progress in nuclear science and the technology which made the large-scale release of atomic energy possible?" Certainly we should seek an answer to the question, "How can we evaluate properly the role of the new process of nuclear fission which modern physics has placed at our disposal?" Or, again, we might ask ourselves, "How has progress in nuclear physics affected the development of other, older, fields in the sciences?" Finally, recognizing that nuclear fission has placed the scientists in the position of co-operating closely with administrators and the military, we might well ask, "How must scientists and engineers adapt themselves to the many new situations which have come about by the development of the new nuclear technology?"

There is no denying that the process of nuclear fission has become most conspicuous by certain direct effects that it produced, particularly in the military sphere, but it is well to remember that the spectacular explosions that we all remember represent but part of the total effects of nuclear fission – one which may, in the long run, turn out to be the lesser part. There are many indirect, and not easily predicted, effects that also take place, and these are of enormous importance, even though they may not be, immediately, so spectacular.

In some sense, nuclear fission is not one of those developments in physics which arose logically and systematically in the course of progress. There was a great deal of accident and surprise in the process. Also, the history of physics provides hardly any parallel to the discovery of nuclear fission, either in the magnitude of the disruptive forces which have been unleashed, or in the magnitude of the social, economic, military, and cultural adjustments we must make as a result, or finally in the rapidity with which all these effects evolved and made themselves felt. Man had no adequate warning, by which he might have prepared himself, systematically, to accept the full implications of the tremendous release of energy which comes about when matter is converted into work. Of course, we have devised and used other significant forms of energy in the past and, in a way, we might say that ultimately nearly all energy comes from atomic reactions of one kind or another. Nevertheless, scientists were not prepared to answer the myriads of questions that suddenly came to the forefront with the first nuclear explosion in 1945, and with its successors during the next decade, in their rapidly increasing sizes. Also, it begins to appear that the release of energy is not the most remarkable, or the most dangerous, manifestation of the nuclear reactions that we can now run on a massive scale. The production of radioactivity and of all sorts of nuclear transmutations may prove to be even more significant.

Uranium Concentrations

We tend to think of atomic energy in terms of uranium – especially uranium 235, which is present in various parts of the world. The concentrations of natural uranium, in the areas in which it is found, vary from a few per cent to a few parts in a million; the concentration of U^{235} in it is uniformly two-thirds of 1 per cent. The key to the entire development was U^{235}; the other important fissionable materials, plutonium and U^{233}, can only be produced with the direct or indirect help of U^{235}. Now, the concentration of U^{235} in ordinary uranium is not controlled by any absolute and time-conserved law. Both ordinary uranium (U^{238}) and U^{235} undergo radioactive decay, and U^{235} decays faster than U^{238}. In a universe in which, as we believe, the heavy elements have been formed about 10 billion years ago, the concentration of the faster-decaying U^{235} has by now decreased to the above mentioned two-thirds of 1 per cent in ordinary uranium. If man and his technology had appeared on the scene several billion years earlier, the concentration of U^{235} would have been higher, and its separation easier. If man had appeared later – say 10 billion years later – the concentration of U^{235} would have been so low as to make it practically unusable. In this case, many of the opportunities, as well as the prob-

lems, which surround us now would have been postponed and transformed in a way that is hard to evaluate.

The process of fission itself is unusual, and this fact alone has presented scientists with a number of obstacles that are not normally encountered.

The chemical elements may be arranged systematically in a table according to their atomic weights. This arrangement is known as the "Periodic Table of Mendeleyev." The elements of middle atomic weight occupy the center of this periodic table and are the more stable ones. Elements of very small atomic weight, at one end of the periodic table, can usually be combined to produce the heavier medium elements, and they release energy in this process (because the medium elements are the stabler ones, as mentioned above). On the other hand, the elements of large atomic weight, at the opposite end of the periodic table, can be broken up into elements of medium weight, and they release energy in this break-up process (again, because the medium elements are the stabler ones). Thus, the light elements can be merged — fused — with a gain of energy, to form stabler heavier elements; and the heavy elements can be broken down — fissioned — with the release of energy again, to form stabler medium elements. These are the two energy-producing nuclear processes: the fusion of the lighter elements, and the fission of the heavier ones. (Actually, the element usually formed in fusion is Helium-4, an exceptionally stable light element, but I need not go into this now.)

Fission and Fusion

The fusion of the light elements was foreseen in detail for some considerable time. The fission of the heavy elements, known to be a possibility in principle, was, nevertheless, unsuspected as a practical matter prior to 1939. In fact, so little credence was given by physicists to the possibility of fission, that nuclear fission was discovered experimentally five years before it was recognized as such and the experiments correctly diagnosed. It was only after every other possibility of explaining the appearance of some unusual disintegration products of the bombardment of natural uranium by neutrons had failed to explain experimental observations — the difficulties were mainly connected with explaining the chemical properties of the nuclear fragments produced — that physicists came to the conclusion that fission had actually taken place.

After the developments of the early 1940's, which made it clear how enormously important uranium was to be in nuclear technology, geologists and others began an intensified search for uranium deposits. As a result, we now know that uranium is not so rare in the strata near the earth's surface as had formerly been thought. The greater than anticipated availability of uranium in itself served as a stimulus to further developments in nuclear technology. The underlying nuclear science has also developed at a very accelerated pace. We know today a great deal more about nuclear reactions in this area and in allied areas than one might have expected 15 years ago.

Indirect Benefits of Nuclear Science

The knowledge, resources, and instrumentalities which have come into being as the result of our study of nuclear fission and other atomic (or rather subatomic) phenomena are being put to good use in the study of many other physical processes. Perhaps this kind of by-product is even more important, in the long run, than all the direct knowledge we have gained from the study of the violent fission reactions by which nuclear matters are most popularly known.

The great developments of nuclear physics proceed in the direction of investigating simple (light) elements and subnuclear particles. Thus, the direct impact of nuclear fission which takes place at the other (heavy) end of the periodic table is less significant than the indirect impact which comes from a better understanding of the nuclear forces and elementary particles in nature. Nuclear reactors which have been built in various parts of this country — and in various parts of the world — now make it possible to obtain an ample source of elementary particles and of all nuclear species — by transmutation — which were entirely beyond the scope of the boldest imagination of 15 years ago. The availability of ample sources of neutrons is especially important. This is indeed a great step forward because it is largely through the use of uncharged neutrons that we are now able to investigate the inner structure of nuclear particles and to perform the classical purpose of alchemy — massive transmutation of nuclear species, that is, of elements, into each other. Before this, we had only charged particles to use as projectiles in our efforts at smashing, transforming, or analyzing atoms. The use of such charged particles required very large energies, that is, very high voltages, for their acceleration; and charged particles could not be easily or well aimed to make hits at the deep core of atoms; that is, one had to make use of brute force methods in all these procedures as long as one was limited to the use of charged particles only. Now that there are ample supplies of uncharged neutrons which can penetrate the deepest recesses of an atomic nucleus with hardly any difficulty, physicists have been able to perform breakdowns, transformations, and structure studies with a much greater ease than was previously possible.

There is another important by-product of research in atomic physics. By means of techniques developed through nuclear science, and through the instrumentalities of nuclear technology, we now have the possibility of effecting many transmutations of elements. We are also able to make almost any element radioactive and, further, have a considerable choice of decay times as well. In this way, we have access to a wide range of radioactive properties. These may be used for examining the behavior of many physiological and industrial processes which could not be satisfactorily studied by other means. Studies of friction and wearing of metal parts, as in internal combustion engines, or the tracing of metabolic substances through the human body by means of radioactive tracer elements, as well as many other things in wide ranges of science and technology, may

be cited as examples of these new and very useful techniques.

There are still other interesting results flowing from the recent rapid advances in nuclear matters. Thus, for some time, but especially since the beginning of World War II, progress in physics has been stimulated by the fact that physicists had frequently worked together in teams, and that such teams often included men from other natural sciences — one field of science cross-fertilizing another. Some of this teamwork was made necessary by the need to bring several different disciplines to bear on a single large problem. But frequently such teamwork was forced upon scientists because the size and cost of the equipment and apparatus required for modern research made group effort essential. While we have certainly benefited from such co-operative ventures, the cost and complexity of modern research equipment has posed very serious problems, often very unaccustomed to the workers in these areas.

Cost of Research

Thus, large particle accelerators cost millions of dollars and years to construct, so that we have very few such instruments, as compared to, say, microscopes. Co-operation is needed in the capitalization, design, construction, use, and maintenance of such large research apparatus. In the construction of a large accelerator, one is faced with the problem of whether it is possible to justify a large expenditure of capital, which, in addition, will only bear fruit half a decade later, at which time both the problems and the available methods may have shifted. Thus one has to ask whether science will not have progressed so far by the time the instrument has been built that it might be obsolete and, therefore, a poor investment. The need for raising funds for research facilities certainly is not new. But the need for underwriting and obtaining capital funds on as large a scale as is now necessary in some areas for scientific research of significance, and to plan for long periods ahead of time, is new to scientists as well as administrators of educational and scientific projects.

In this regard, the developments in nuclear science have had an enormous additional effect on all of us who are involved in these fields. We have acquired much more routine in evaluating and organizing team-work, in assessing the desirability of large and long-range material commitments, and so on.

So far, I have discussed only the effect of nuclear reactions on the professional work of the physicists; but other groups have been influenced with equal intensity. We all know that nuclear fission has already revolutionized many military areas of operation and that it has necessitated tremendous effort and expense to build up and develop a military organization which is able to meet and overcome a modern atomic-powered military machine.

However, even greater than its impact on the military organization is the impact which it has had in changing the thinking and lives of the civilian population. Nuclear science has, in fact, affected greatly our way of thinking about our civilization.

Scientists who made the control and release of atomic energy possible were among the first to feel the changes which this astounding development entailed. They are no longer free to carry on their research in isolated "ivory towers" completely free from the need for accounting for the possible uses of their discoveries. They are a very decisive part of our atomic age civilization. For the first time, they are, of necessity, concerned with problems of security and national welfare on a large scale and in a way never before encountered by them. They have to think and be guided in many operations much as military men had to think and be guided in former periods; and they are not accustomed to what seems to them to be undue regimentation. They need to develop, therefore, new habits and techniques. They now have new and vast responsibilities for which they were in no way prepared. Like every radical and unexpected adaptation which, in addition, has to be carried out in a hurry, it is painful, disconcerting, and accompanied by violent emotional fluctuations. But, by and large, the adaptation takes place with an admirable speed, especially if one considers all the factors that intervene and all the difficulties I have tried to indicate.

Scientists in Other Roles

Pure science is often abstruse, and yet scientists may today be called upon to fill positions of considerable responsibility in fields outside their professional area of competence. They may become administrators, they may have to influence public opinion; all in all, they have great social responsibilities. We must expect that other phases of abstract thinking, other than physics and chemistry, may also ultimately evolve into similar roles; that is, they may assume military, economic, and more generally social roles of equally tempting, compelling, and dangerous aspect. Science and scientists have become affected with the public interest in a new way and in orders of magnitude that were never imagined a half century ago. Scientists, and physicists in particular, have had to undergo a new kind of adjustment and discipline. We must develop procedures and institutions to meet the new adjustments with which we are confronted. The adjustment will be painful in the future, as it has been troublesome and painful in the past. There is no easy way out of this situation, but with intelligence and good will some satisfactory way can and must be found.

The social responsibility of scientists has been vastly increased since the first chain reaction was set off in Chicago in 1942. The responsibility of scientists has grown especially in the field of international relations. We must recognize that the education of the scientist of the future is not complete as long as it is limited to his technical professional subjects; he must know something of history, law, economics, government, and public opinion. Our task is to make the adjustment to new conditions as satisfactory as possible. We must do this intelligently and promptly. But we must do it without endangering the foundations upon which the sciences themselves rest and thrive.

Radar and the Weather

The Development of Microwave Radar Technique Provides a New Tool to Help Close the Gaps in Our Knowledge of Rain Clouds, Thunderstorms, and Tornadoes

By HENRY G. HOUGHTON

THE only contact most persons have with meteorology is through the daily weather forecast, and it is not surprising that meteorology is so often considered as a synonym of weather forecasting. Actually, meteorology is the science of the atmosphere, and forecasting is only one area of applied meteorology. The atmosphere is perhaps the most important part of our physical environment. Food supplies and that *sine qua non* of civilization, ample fresh water, depend critically on weather and climate. Atmospheric pollution, that bane of industrialization, is a meteorological problem. Proper consideration of climatic factors can avoid a repetition of the unhappy results of the industrialization of the Los Angeles area.

I need not speak of the tremendous losses of life and property due to hurricanes, tornadoes, floods, droughts, and the like, but I should point out that the consequences of such catastrophies have continued, and will continue, to increase with enlargement of population density. In less dramatic ways our personal lives and fortunes are almost daily affected by the weather. In a larger sense the peaceful progress of the world will depend, in growing measure, on the more effective utilization and conservation of our natural resources. Weather and climate will be a determining factor in efforts along these lines.

Mitigation of the effects of severe storms, and efforts to maximize the beneficial effects of climate, must be based on a thorough knowledge of the behavior of the atmosphere. In view of its importance the slow progress of meteorology is perhaps surprising. There are a number of reasons for this. Few industries depend critically on the weather and hence private enterprise has not played an important role. On the scale required, the collection of data is a tremendous undertaking, and can be accomplished only by national governments. Poorer countries have lagged behind and have left unexplored vast reaches of the atmosphere, but weather does not recognize national boundaries. Plagued by the lack of adequate data and by penurious support of government, meteorological research moves forward with great difficulty.

In World War II, the critical importance of weather to military operations focused the attention of the military departments on meteorological research, and for the first time, fairly substantial funds were provided. Fortunately, the military services have been foresighted enough to continue this support. The war also gave impetus to the expansion and improvement of the world-wide collection of weather data. Armed with these resources, meteorological research has made rapid strides in the last few years. For the first time we are now able to break away from the qualitative and empirical approach and embark on truly quantitative investigations. In spite of this heartening progress, the effort is still small compared to the potential benefits.

In the absence of a meteorological industry, the role of the Department of Meteorology at the Institute differs from that of most of the other courses.

Professor Houghton's timely article represents several innovations. It deals authoritatively with recent developments in several fields of science and represents a blending of progress in the fields of electronics and meteorology. His article also represents the text of the first of three papers on "Research Progress at M.I.T." presented before 350 Alumni officers at a conference held at M.I.T. on September 9 and 10. It seems not unlikely that similar conferences may provide a new technique by which The Review can report M.I.T. progress to its readers.

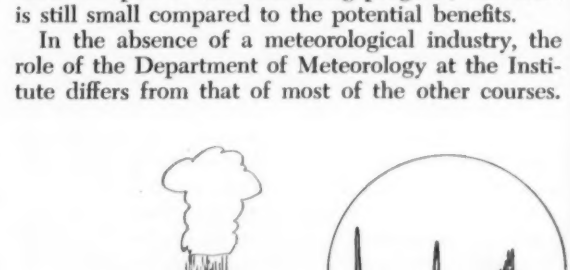


Fig. 1. The simplest type of radar presentation is that illustrated above, in which horizontal distance represents range or distance and vertical distance represents intensity of reflected signal.

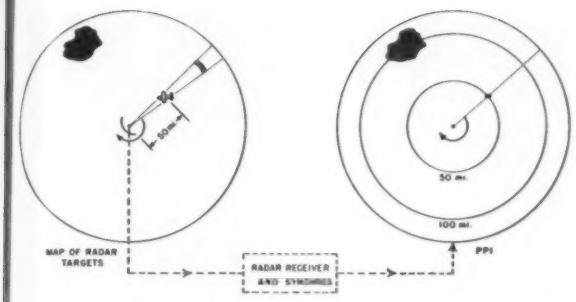


Fig. 2. Plan position indicator type of radar presentation portrays a radial map of the region around the radar station in the center.

Research is the pressing need and our efforts are largely devoted to training research workers and to carrying on a broad research program: these are activities that mutually support each other. To permit us to concentrate on this program we have recently decided to drop our undergraduate program. Undergraduates who are interested in meteorology will be advised to pursue Courses in Electrical Engineering, Physics, or Mathematics in which they can take some meteorology subjects as electives and acquire a sound scientific and mathematical background for graduate training in meteorology.

Meteorology is still largely a governmental monopoly. The agencies involved (such as the Weather Bureau) are primarily operating organizations, and for them research is a secondary function. As the first, and one of the few, departments of meteorology in the country, it is our responsibility to lead the research effort and to provide highly trained graduates.

Time does not permit the telling of something about each of our seven major research programs, but one of the most promising developments is so significant that it must be mentioned here. Through brilliant theoretical research, coupled with a painstaking examination of world-wide weather data extending into the stratosphere, it now appears that one of our research groups is in a fair way to setting up a mathematical model of the fundamental circulation system of the entire atmosphere. This model can be put on M.I.T.'s great digital computer, Whirlwind I, and thus give us a working model of the atmosphere in quantitative numerical form. If successful – and successful it will surely be sooner or later – it will not only provide us with extended-range, weather forecasts, but it opens up even more fascinating vistas. With such complete understanding of the mechanism, it is possible that the way will be opened to weather control – and the extent and design of such control can be tested on the mathematical model in Whirlwind I. This is a striking illustration of the quantitative approach to meteorology that is now emerging. It is important to note that such research can be carried out only because of the unique combination of facilities and skills here at the Institute.

One of the striking features of meteorology is the vast range of scale of the phenomena we study. I have just alluded to the world-wide circulation patterns with a scale of thousands of miles. Near the other end of the scale, we are concerned with the deposition of water molecules to form snowflakes. There are equally important phenomena at all intermediate sizes. Because of the tremendous cost, the standard meteorological observational stations are spaced not much closer than 100 to several hundred miles apart. This means that many important phenomena, such as tornadoes, thunderstorms, and the details of rain clouds, slip through this coarse mesh undetected.

The development of microwave radar during World War II has given us a new tool to close these gaps and I have chosen to tell you about our work in this field because of its importance, the example it gives of the more complex gadgets now being used, and because it is readily illustrated. Weather echoes were first discovered in the early operational uses of microwave radar and were called "weather clutter" because they tended to obscure aircraft targets. A few progressive military meteorologists used radar to track showers during the war but little was known of the full potentialities and limitations of this new weather instrument. Shortly after the end of the war, we entered into a contract with the Signal Corps to explore the uses of radar in weather research. This work is still continuing and much has been learned, only a little of which can be mentioned here.

Radar Operation

Most readers of The Review know how radar works. A short pulse of radio energy generated by a transmitter is beamed toward the target. A little of the energy striking the target is reflected back to the source where it is detected by a radar receiver. The time taken for the pulse to go from transmitter to target and back is a measure of the distance between the radar station and the target. The azimuth and elevation of the target is given by the orientation of the radar antenna or "dish." The weather targets are raindrops and snowflakes – cloud drops are usually too small to be "seen." The multitude of drops in the radar beam are in relative motion and the return signal has a characteristic scintillation. The illustration in Fig. 1 shows a schematic of the simplest type of radar presentation – the "A" scope on which horizontal distance represents range and the vertical distance is a measure of the intensity

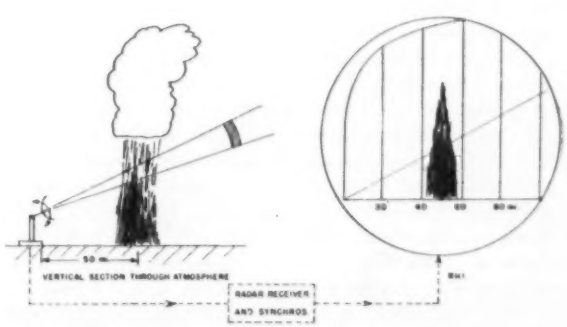
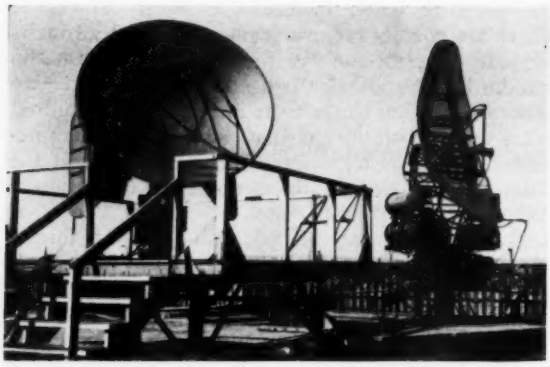
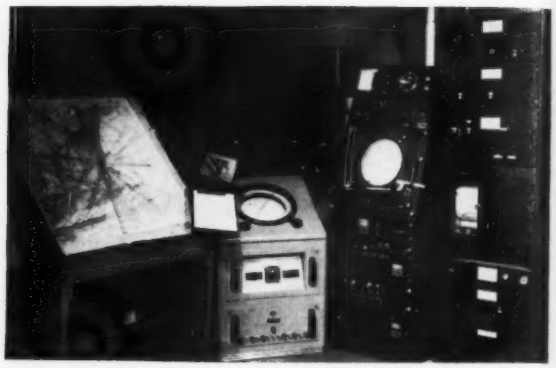
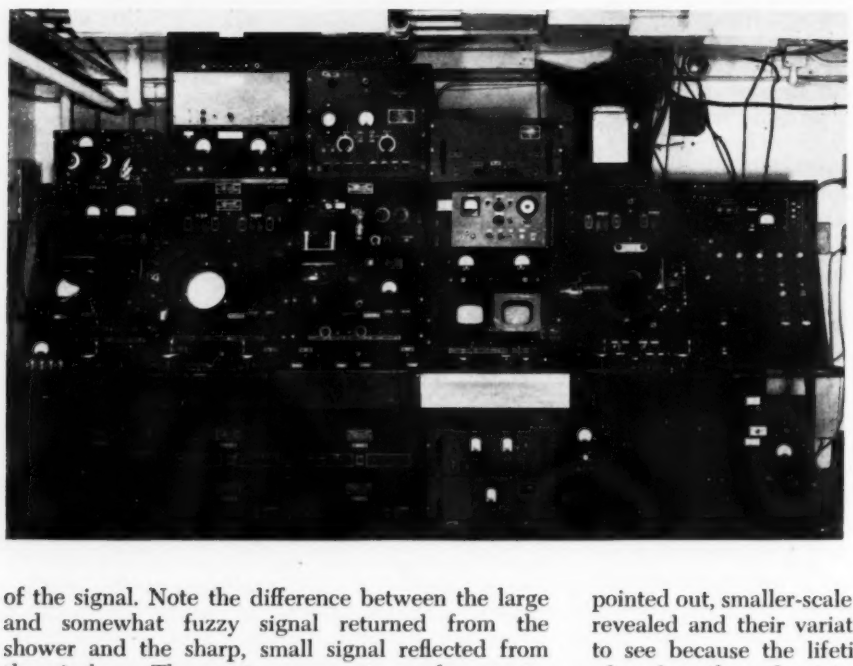


Fig. 3. Range-height presentation on radar screen shows the distance and height of reflecting objects in a fixed azimuthal direction.







Above, left: *Fig. 4. Two radar antennae on the roof of Building 24 in which the Department of Meteorology is located. The dish antenna on the left is used on plan-position indicator systems, whereas the antenna at right is used for range-height determinations.* Left: *Fig. 5. Radar equipment and control panels in the Radar Room of the Department of Meteorology at M.I.T.* Above, right: *Fig. 6. Cathode-ray equipment on which radar images are displayed.*

of the signal. Note the difference between the large and somewhat fuzzy signal returned from the shower and the sharp, small signal reflected from the airplane. The most common type of presentation – the plan-position indicator which is essentially a horizontal map with the radar at the center – is shown in Fig. 2. The range-height presentation in which the radar beam is scanned up and down in a vertical plane at a fixed azimuth is illustrated in Fig. 3. Two of the radar antennae on the roof of Building 24 here at the Institute are illustrated in Fig. 4, whereas Figs. 5 and 6 show some of the equipment in our Radar Room.

Almost at once it was apparent that radar could be used to track convective showers, approaching cold fronts, and the like, and so yield a fairly precise very short-range forecast of the arrival of such storms. This can be important at an airport where a half-hour warning of a violent local storm is often sufficient. We were not concerned with such relatively obvious and simple uses but desired to use radar as a research tool to reveal phenomena not otherwise amenable to study.

The atmosphere is three dimensional and subject to relatively rapid time variations. Conventional meteorological observations give us an instantaneous picture at a discrete number of points. As previously pointed out, smaller-scale phenomena are imperfectly revealed and their variations in time are impossible to see because the lifetime of the phenomenon is often less than the interval between observations. Radar, however, gives us a nearly continuous picture with excellent detail. On the other hand its range is limited by the curvature of the earth to the order of 200 miles and it "sees" only precipitation. The latter limitation is not too serious because precipitation accompanies almost all interesting weather phenomena. As with any new instrument, new concepts and methods must be developed to use it most effectively.

There are two characteristic types of precipitation: these we call shower and stratiform types. Showers range in intensity up to thunderstorms and are characterized by large vertical extent of the cloud, high vertical air speeds, heavy rain, small horizontal extent, and relatively short lifetimes. Stratiform precipitation is that characteristic of our northeast storms in which the rain or snowfall is more moderate, and the vertical air velocities small, but precipitation covers very large areas and may last for a day or more.

Radar techniques have made it possible to study the life history of such showers. Their total lifetime is of the order of one hour. The echo first appears

at an intermediate height and then grows both up and down. From these observations, and related theoretical studies, we now know that the genesis of the rain drops occurs in the lower part of the cloud. These small drops are carried up by the strong vertical air motion, growing all the time by collisions with much smaller cloud drops, until they finally have a fall velocity exceeding the upward air velocity whereupon they begin their fall back through the cloud toward the earth.

A series of range-height oscilloscope photographs of stratiform precipitation is shown in Fig. 7. Note the rapid variation in structure. The tuft-like structure shown here is characteristic of most stratiform precipitation. What is shown here is snow which forms in rather small generating cells of convective origin. That it is snow is indicated by the sharp slope of the streamers, a result of wind shear. At the melting level the radar reflection is enhanced forming the so-called "bright band." The radar reflectivity of a particle depends on the sixth power of its radius and on whether it is ice or water. When the snowflakes begin to melt they are covered with water but they are still of snowflake size. The thin film of water makes them act as large water drops which reflect much better than dry ice. As the melting proceeds, the particles collapse to much smaller, faster falling water drops which consequently have a lower reflectivity.

From extensive studies we now know that stratiform precipitation starts as snow at moderate heights of from about 20,000 to 30,000 feet. As the snow falls it grows by sublimation of the vapor – a process that is greatly enhanced when it passes through a supercooled water cloud. Just above the melting level the individual snow crystals tend to stick together to form clumps or the usual snowflakes. After melting into rain drops, further growth may occur by collisions with drops in lower clouds.

Radar Watches Storms

A number of examples of radar oscilloscope photographs have been shown and we have photographed more in motion pictures. Valuable though these pictures are, they do not give the quantitative information we require for our research. We measure the returned signal with special instruments and correlate such measurements with the rainfall. It now appears that the rainfall over an area can be determined by radar in more detail and with comparable accuracy to that of conventional rain-gauge networks.

I mentioned previously that the fluctuating or scintillating character of radar weather echoes is due to the relative motions of the multitude of precipitation particles. We have devised special instrumentation to determine the frequency spectrum of these fluctuations. Careful analysis with the aid of the electronic autocorrelator and Whirlwind I computer have enabled us to interpret these fluctuations in terms of the turbulence in the free atmosphere.

Recently we have been carrying out interesting experiments with a variable polarization radar. This

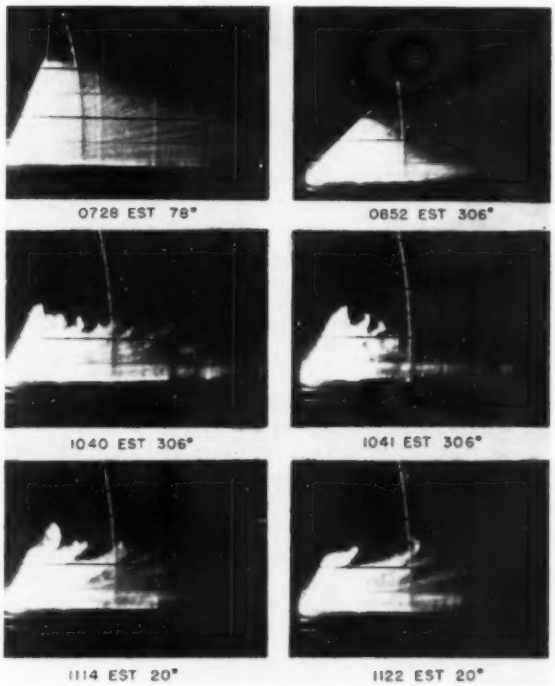


Fig. 7. A series of range-height oscillograms of stratiform precipitation.

shows promise of giving us information on the orientation and shape of snow crystals and for distinguishing between snow and rain. These studies are also valuable to those concerned with air defense radar who wish to reduce weather echoes, and we are collaborating closely with Project Lincoln on this aspect of the work.

As you will have noted, our utilization of radar is aimed at gaining a better understanding of those atmospheric processes that it reveals so well. However, we are not unaware of, nor are we uninterested in, the more operational uses of weather radar. Because of its limited range, radar networks are being established in many sections of the country. In this way the gaps in our conventional network can be filled in and forecasting will be improved thereby. As I have emphasized, radar is most valuable for very short-range forecasting. This means that it will be most immediately useful for giving warnings of tornadoes and severe thunderstorms. Along the East Coast radar offers a useful supplementary means for tracking hurricanes.

Although radar will aid the weather forecaster, it must not be expected that it will revolutionize weather forecasting. Real improvement in forecasting will be based only on our gaining a more complete understanding of the atmosphere in all of its facets. This is what we are so earnestly trying to do, utilizing all of the tools at our disposal. No one of these tools – be it radar, digital computers, or space satellites – will, of itself, supply the answer. The problem is vastly complex and we still have far to go but we are particularly optimistic at this time as we see many of the pieces of the jigsaw puzzle falling neatly into place.

Alumni Officers' Conference

First Event of Its Kind Brings 350 Class Officers, Honorary Secretaries, and Educational Counselors Together for Two-Day Work Session at the Institute

This year's President, Dwight C. Arnold, '27, presents gavel to Hugh S. Ferguson, '23, in recognition of service as President of the Association for 1954-1955.

All photos by M.I.T. Photo Service

ACTIVITIES of the school year opened at M.I.T. on September 9 and 10 with a conference planned especially for Class and Club Officers as well as for Honorary Secretaries, and members of the Educational Council. Approximately 350 Alumni attended this conference; they lived at Baker House (where they had opportunity to learn how today's Tech students live), had opportunity to meet with about 50 members of the Institute's Faculty and administrative staff, and had opportunity to compare the Institute of 1955 with the M.I.T. of their college days.

To most out-of-town Alumni, the M.I.T. Chapel and Kresge Auditorium – where conference sessions were held – were completely new. Some of those who remembered the Institute as it was when they were students had their first opportunity of seeing the Charles Hayden Memorial Library, the Metals Processing Laboratory, the Supersonic Wind Tunnel, the Chemical Engineering Building, Building 24 (used as a center of radar activity during World War II), the Sloan Building, and the Dorrance Laboratories of Biology and Food Technology. All could see excavations where the Karl Taylor Compton Laboratories of Physical Science are now under construction. Athletic and housing facilities, such as the Rockwell Cage, Baker House, Burton House, and the community for married students – under the names of Westgate and Westgate West – were pleasant innovations to others.

But to those who have not been able to follow closely the progress in Cambridge during the past decade or so, the changes in educational techniques, the substantial increase in research as a means of education at the forefront of technology, the improved facilities for student life, and the many tangible manifestations of the Administration's success in training the "whole man" probably represented the most impressive deviations from the Institute of the days prior to World War II.

Of course, it was impossible to examine in detail all the changes that have recently occurred at the Institute, especially since the student body and Faculty had not yet gathered for the beginning of academic events. But there was ample opportunity for those in attendance to glimpse the more important innovations, and having seen, conference delegates could return to their communities with a better concept of the M.I.T. of today. Older Alumni who cannot shake the idea that "Tech is hell" certainly must have left the conference with a distinctly improved impression of the latter place of abode.

President of the Alumni Association for the year 1955–1956, Dwight C. Arnold, '27, served as master of ceremonies and opened the conference with words of welcome. Speaking in the Kresge Auditorium on Friday morning, September 9, Mr. Arnold said:

It is my great privilege to welcome you to this First Alumni Officers' Conference on behalf of the Alumni Association of M.I.T. As the late Karl T. Compton, chairman of the M.I.T. Corporation, stated in his opening remarks at President Killian's inauguration on April 2, 1949: "By your presence you honor us. Your presence and friendly interest are more than a symbol of our common faith in the great values of scientific progress and sound education; they are a positive source of encouragement and inspiration to this institution. . . ."

To this I would like to add that the officers of your Association, and those on the Faculty and Administration who have helped us prepare for this conference are delighted that so many of you have found it possible to join us for this day and a half at M.I.T.

Any Alumni close to M.I.T. and its problems have confidence and faith in the social importance of the Institute's objectives; have faith in the men who are responsible for its administration and performance; and have confidence that they will have the backing required in each step forward. But the M.I.T. of 1955 is a changing institution, and your Executive Committee felt that the officers of our Association would appreciate this opportunity to see and hear firsthand some of the changes that have taken place since their graduation, but more particularly, the changes which are now going on and being contemplated.

The theme of President Killian's inaugural address six years ago was the three imperatives which the Institute at that time faced: first, it must continue the creative contributions which science and engineering can make to modern life; second, it must educate for professional and social responsibility; thirdly, we must maintain the freedom and independence of our institutions. This is basically the theme which your committee has followed in setting up the program.

Educational Progress at M.I.T.

Mr. Arnold then introduced George R. Harrison, Dean of the School of Science, who conducted the remaining morning program on "Educational Progress at M.I.T."

In opening the program on "Educational Progress at M.I.T.," Dean Harrison reminded his audience that, as a result of the substantial postwar increase in population, the United States faces a critical and

necessary expansion in educational facilities for the next decade or two. Keeping this in mind, it is evident that M.I.T. too must grow if it is to maintain its present relative position among higher educational institutions. Although the need for expanding educational facilities is generally recognized, not yet solved are the subsidiary questions of how to maintain quality of product, and how M.I.T. activities must be related to future needs.

Since about 1930 the enrollment at the Institute has been controlled, said Dean Harrison, and this practice has made it possible to keep M.I.T. facilities reasonably well balanced according to the demands that are made on them. At the present time the M.I.T. student body numbers 3,600 undergraduates, and 2,100 graduate students, or a total of 5,700 students in all. This enrollment, larger than at any other time in the Institute's history, places a heavy burden on Institute personnel and facilities, particularly in the Courses of Electrical Engineering and Physics. Prior to World War II there were about 150 students per year studying physics; today that number is about 500 students. In addition to these students who pursue the professional course, the Department of Physics is called upon to offer service courses in physics to all freshman and sophomore students. Similarly, there has been an increase of 30 per cent in the enrollment of the Department of Mathematics since the beginning of World War II, and about the same increase in the Department of Chemistry. Nevertheless, in Civil Engineering, Aeronautical Engineering, City Planning, Meteorology, Chemistry, Food Technology, Geology, and Biology, Technology could train more students.

All estimates of college enrollment predict a doubling of enrollment during the next decade. In 1930 about 2,000,000 were in colleges; by 1942 this figure had risen to 3,000,000; and today the college enrollment is about 4,000,000. The Administration is keenly aware of the Institute's educational responsibilities and is prepared to help M.I.T. to grow as the national college enrollment grows. But even more important than growth in size is the Institute's special responsibility to maintain its program of education at a level of high quality. This can be assured only if those who come to the Institute are properly selected and have the foundation and training to benefit from M.I.T. instruction.

Although the number of students who fail for scholastic reasons is not large, nevertheless, every such person represents a waste of effort. The effect is harmful to the student who flunks as well as to M.I.T., but we cannot afford to overlook the injustice done to some other applicant who might have made a better record had he been given opportunity to enter Technology. Admittedly predictions of human behavior are difficult to make, but if Honorary Secretaries – and others responsible for admitting students to the Institute – can improve their procedure of selection, the number of failures can be still further reduced.

At the present time, graduates of the Institute are in great demand for positions in industry, in the government, or in education. They will undoubtedly continue to be in demand, even in less prosperous times than the present, for a high quality product is always most desired.

Dean Harrison also reminded his audience that technical education continually becomes more demanding. It now requires five or six years at the college level to train a person competent to do engineering work; it takes at least seven years to train a competent scientist. The educational process cannot be hurried. Yet the trend to extend professional education over longer periods is unmistakable, and accounts for the recent acceleration without sacrifice of quality in graduate study. In the future it is not unlikely that graduate work will be as necessary, and will take as much time, as is now required in undergraduate studies. When the importance of first-class personnel is considered, the seven or eight years needed to train a leader is hardly much of a sacrifice from the national point of view.

The Institute's role in supplying competent scientists and engineers is a highly creditable one. Of approximately 2,000 who receive doctorates in physical sciences in the United States each year, roughly 8 per cent receive their training at M.I.T. The Institute also trains about 3 per cent of those who receive Ph.D. degrees in chemistry each year. In mathematics, the demand for those with doctorates is greater than in any other field of physical science. Again, M.I.T. trains about 3 per cent of the national total. But it is estimated that 7,000 Ph.D.'s will be needed in mathematics in the next decade, and this need is not now being met. Similar situations exist

Participants in the Friday morning session on "Educational Progress at M.I.T." were (left to right): *George R. Harrison, Dean of the School of Science; Nathaniel H. Frank, '23, Head of the Department of Physics; John E. Arnold, '40, Associate Professor of Mechanical Engineering; and John E. Burchard, '23, Dean of the School of Humanities and Social Studies.*

in other fields of science, as well as in engineering. Still, the need continues to exceed this supply.

The Institute faces a number of significant limitations in maintaining quality of instruction while simultaneously educating larger numbers of students. One of these is that of physical space. The Karl Taylor Compton Laboratories in the physical sciences will remedy some of the current limitations of space, but certainly not all. Moreover, the Compton Laboratories will serve primarily as a replacement for outmoded and inadequate existing facilities; for the most part the new laboratories do not provide for new facilities. Another limitation is that of personnel. Although the Institute has an active, alert, enthusiastic, and energetic staff, the teaching load it is required to handle is reaching the saturation point; the load cannot be greatly increased without deleterious effects.

When all significant factors have been taken into account, said Dean Harrison, it appears that the Institute must concentrate primarily on maintaining a high quality of instruction at all levels of education in science, engineering, and architecture. The problem of growth and expansion, however important, must be a secondary consideration.

The remaining speakers of the morning session, said Dean Harrison, would elaborate on his general remarks, each in his own way, emphasizing activities in a particular department. Following Dean Harrison as speaker in the morning program was Nathaniel H. Frank, '23, Head of the Department of Physics, who has been at M.I.T. at least 35 years. Dr. Harrison recalled that Professor Frank heads the largest Department of Physics in the United States; he is an outstanding teacher of physics in his own right, and understands thoroughly the relation between research and instruction.

Undergraduate Laboratory Instruction

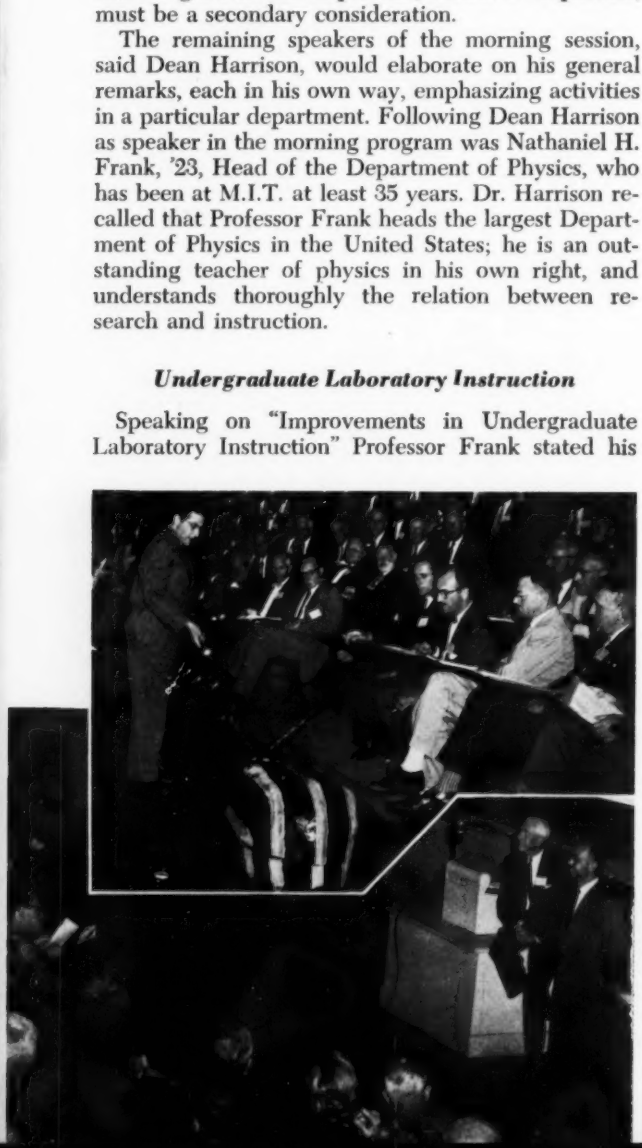
Speaking on "Improvements in Undergraduate Laboratory Instruction" Professor Frank stated his belief that the objectives of any laboratory are to: (1) enable a student to become acquainted with laboratory techniques and physical equipment; (2) permit verification of physical principles and formulas derived from these principles; (3) provide insight into the way in which new quantitative factual data are uncovered.

Professor Frank believes that one cannot get a real basis and feeling for any one of the great principles of physics from any single experiment – or even from a few experiments, no matter how good they may be. Principles are synthesized from a multiplicity of experimental results, sometimes of widely different character; they are derived from many concepts, some of which are quite subtle and sophisticated. Nevertheless, specific information concerning physical facts can be obtained in the laboratory, and there are many cases where a single good experiment suffices to provide such information.

In addition to these aims which apply to any laboratory in science or engineering, Professor Frank stated his belief that laboratory instruction in physics should demonstrate the further objectives to: (4) develop a feeling for orders of magnitude of physical quantities in real experiments, to generate intuitive judgment as to the significant and secondary pertinence of different variables, and to learn how to devise ways and means of minimizing and correcting for unwanted and extraneous effects in a given experiment; (5) develop, with the help of objective (4), a proper understanding of the inherent approximate nature of physical measurements, and an appreciation of the limits of validity of mathematical solutions of academic problems of physics, no matter how erudite the latter may be, and finally; (6) introduce some new area of physical concepts and experience.

These aims require inspired teaching and experiments designed so as not to present an oversimplified situation in which real physical factors have been concealed. The attainment of this objective, set forth in item (4), is essential in combating the evils arising from exclusive concentration on "book" problems, independent of the level of analytic difficulty of the latter.

If all of the above objectives are to be attained, Professor Frank believes one must forego attempts to obtain strict correlation between the laboratory



Speakers on "Research Progress at M.I.T." were (top left): *Leonard A. Gould, '48, Assistant Professor of Electrical Engineering;* (lower left): *C. Richard Soderberg, '20, Dean of the School of Engineering [seated], and Henry G. Houghton, '27, Head of the Department of Meteorology; and* (right): *Thomas H. Pigford, '48, Associate Professor of Nuclear Engineering.*

and lecture material. It should be one of the goals of the laboratories to devise significant laboratory experiments which provide the student with a first acquaintance with some area of physics. In addition, there should be an accompanying intellectual challenge of learning something new by trying to extract it from an individual experimental experience, instead of having it presented as an authoritative dictum by either the text or the lecturer. This item can become of utmost importance and perhaps should be the ultimate focal point of laboratory objectives. From this can emerge an appreciation of the enormous complexity of real physical situations, the equally great simplification which such situations require if theory is to be applied to them, and the reasons why this is a healthy state of affairs and not one to be deprecated.

Professor Frank emphasized his belief that under no condition must the laboratory be regarded as a peripheral segment of the physics course; it is fatal to education to regard laboratory work as routine, and of no special significance in the learning process. We must remember that some individuals derive great satisfaction – and hence learn best – from experiments; others are stimulated best by mathematical analysis and the aesthetic satisfaction derived therefrom; a few derive equal satisfaction from both processes. Proper balance between the laboratory effort and the rest of the course is essential to obtain optimum effectiveness. Professor Frank stated that no laboratory experiment should allow puttering around, without requiring a sharp and nonsimple reasoning process, whether the experiment is precise, or of limited precision, or even qualitative.

With such a statement of aims for the laboratory work, Professor Frank recounted recent experience of the Department of Physics in devising a group of experiments for freshmen and sophomores. Such students are required to do but eight or 10 laboratory experiments each term – although a larger number is permissible for those having special interests and abilities – but each experiment is designed to stimulate the student's intellect and present a challenge to his abilities. Whenever possible, students who have a particular experiment in which they are interested, are permitted to perform it, provided it is set up so as to make a real contribution to their understanding of physical processes and does not entail time unwisely spent in the laboratory.

The close interrelationship between research and education at M.I.T. makes it possible for laboratory experiments to have real value. In some instances experiments that are first performed in research laboratories are simplified and refined to be capable of accomplishment by upper classmen in the physics courses; later, further refinements may make the experiment suitable for use by the freshmen or sophomores. In some cases, students are permitted to undertake laboratory work in one of the research laboratories around the Institute.

The instructors are enthusiastic about the current program in laboratory physics. Like the students, they feel the program is a real one worthy of their fullest support because it represents a challenge. The program is relatively new and is still undergoing change. But on the basis of what experience has been obtained thus far, the results obtained are highly encouraging, said Professor Frank.

New Departures in Education

Dean Harrison next introduced John E. Arnold, '40, Associate Professor of Mechanical Engineering, as a member of the Institute's Faculty who "stretches the student's mind and imagination." Professor Arnold took his bachelor's degree in psychology and subsequently took his S.M. degree in mechanical engineering at M.I.T.

Speaking on "New Departures in Education" Professor Arnold stated that since man first emerged from his cave in prehistoric times, he began to classify his responses and to make use of those practices which he found to be successful. His first attempts at classification were feeble. His early successes were based on demonstrations; later he progressed to the use of abstractions. He began to modify and change the patterns he found were successful, and to improve upon them; he also developed a critical attitude which facilitated his progress. Likewise, an effort is made to instill in Technology students a desire to inquire, to doubt, and to investigate, and this objective is approached from several different points of view. A course in Creative Engineering in the Department of Mechanical Engineering is given with this objective.

In a sense, it might be said that "creative engineering" is a term involving redundancy, for engineering should be creative. But some engineering, unfortunately, is not creative, and certainly not everything creative is engineering. What Professor Arnold means by joining these two words together implies a welding of psychology and engineering.

How does it happen that a course of instruction at M.I.T. is a combination of psychology and engineering? The outcome is largely because Professor Arnold first became interested in psychology and later pursued training in mechanical engineering. His first assignment at M.I.T., about a decade ago, was to teach Machine Design. This course was originally typical of such courses, and the student was expected to come up with a single proper solution that could be readily checked by the instructor. Although the course was a good one, it was not presented in the manner in which students would encounter problems in their professional engineering work. Because too much emphasis was placed on analysis the problems given were not like those encountered in real life. Accordingly, the course was changed to emphasize the aspect of synthesis, rather than analysis, and the evaluation of the problem became an important part of the situation confronting the student.

When such an approach is tried, it becomes clear that many problems of a nonanalytical character assume considerable importance, and that there may be many solutions to a problem, all equally valid, and requiring the student's attention. In altering the course to emphasize the need for judgment and synthesis as well as analysis, two important pedagogical problems immediately arose. One of these was to determine how to develop new ideas, and how to stim-

ulate initiation and inventiveness or creativeness on the part of the student. The other problem was to consider the solution of a problem in terms of man's characteristic responses in a given environment.

The course in Creative Engineering, as currently given by Professor Arnold, might be considered as involving some aspects of the psychology of invention as well as on human engineering. The work in the course on Creative Engineering is based on four hypotheses. The first of these is that people are born with a certain degree of creative capacity which can be developed. The second hypothesis is that innate creative capacity is independent of other abilities which a person may have, and which, therefore, should be capable of independent development. The third hypothesis is that the potential creative abilities of a person can be developed by study and training. The creative process must be properly oriented in time, and does not end until a useful result has been achieved. Finally, the fourth hypothesis is that the ability to analyze, synthesize, and critically judge and evaluate a situation makes its contribution to the creative process.

One may well ask how students are to be instilled with the creative urge. In a discussion of the ideas of semantics and psychology, it is important to ask questions – properly – as well as to be able to answer them once they are formulated. We do not wish to precondition the mind of a person in the way in which a question is asked; in other words, said Professor Arnold, the course should be devoid of "loaded" questions. We wish also to emphasize the importance of the individual as the only creative tool.

The course in Creative Engineering is given through the use of case studies. The student is given a problem – broad in scope – and he is required to make a study of his problem and to write a report of his finding which is then judged by a jury outside of the Institute. The work of the course is also conducted by means of seminars. The evaluation and judgment which the student gives to his problem is regarded as of extreme importance; the assumptions he uses must be examined to see whether they are valid; they must be supported, and any solution which is proposed must be in accordance with these assumptions. The student's solution must also be based on common sense, and it must be economically, as well as technically, feasible.

Eventually it is hoped that the course may lead to a program in the training of comprehensive designers. Such an objective must be nourished by very broad concepts on an international basis. Of course, the successful designer must be able to use the materials of engineering in a proper way. But he must also know the environment in which his product is to be used; the use to which it is to be put; how it is to be made, machined, and sold; how it satisfies the needs of man – or other ultimate user. The comprehensive designer must know something of the several processes of communication systems – aural, visual, and written. He must be able to balance his ability to analyze, to synthesize, and to judge. In short, he must be able to use and further develop the creative process. In this objective the course in Creative Engineering represents a new departure in education.

Humanities Program

Final speaker of the Friday morning session was John E. Burchard, '23, Dean of the School of Humanities and Social Studies, who reported on progress in this relatively new school at the Institute. Dean Burchard took pains to point out that the Institute's program in instruction has always provided for general studies (now called humanities) and that the changes which have come about in the curriculum since the School of Humanities was organized are ones of degree rather than of purpose.

Dean Burchard took obvious pleasure in recalling that the Institute has always had an outstanding Faculty in the humanities. In the past quarter century such personalities as Davis R. Dewey, Robert E. Rogers, Donald S. Tucker, Henry L. Seaver, Henry G. Pearson, Ernest F. Langley, Herman R. Kurrelmeyer, and Penfield Roberts were singled out for specific mention. The Institute's Faculty has also included such well-known historians as Carl Bridenbaugh, Harold U. Faulkner, Crane Brinton, and Frank Aydelotte – thereby proving that an understanding of technology is certainly no barrier to success in fields other than science and engineering.

There is a vast difference, said Dean Burchard, between the courses of instruction in the humanities as taught at a technological institute and those taught in liberal arts college or even in a university. At M.I.T. the Faculty of the humanities is respected and on an equal footing with other Faculty members; there is also a spirit of co-operation which is frequently lacking in some universities where the faculties of various schools do not come into contact with, and hence do not really understand one another.

The humanities and social sciences are an integral part of education at M.I.T. Their purpose in the curriculum is to impress upon the student how important human relationships are in any society, and to develop in him the first-rate human and social values which must accompany technical competence if an individual is to make his maximum contribution as a citizen.

The four-year program is based upon the theory that to achieve a well-balanced professional education a student should pursue these studies simultaneously with his studies in science and engineering. The program is constructed in a manner that will insure the student some breadth in the humanities during his first two years and some depth in a more limited area of either the humanities or social sciences in his third and fourth years.

Freshmen entering the Institute are required to take a course in Foundations of Western Civilization – taught to one section by Dean Burchard. This topic involves a study of the individual in his relationship to society and of the moral and intellectual problems involved in this relationship. During the first term, emphasis is placed on two societies in the premodern period which have contributed significantly to contemporary civilization and are remote enough in time and place to provide contrasts to contemporary social organizations and behavior. One of these is a study of Athens in the Fifth Century B.C.; the other is a study of France in the Thirteenth Century. Works by

Bruce F. Kingsbury, '44, Executive Secretary of the Educational Council (left) *speaks on "Educational Council and Honorary Secretaries" in a lecture room in the Eastman Laboratories.* (Right) *Those attending the buffet dinner at Walker Memorial were treated to delicacies prepared by Walker Memorial chefs in the newly redecorated student center.*

More, Shakespeare, Hobbes, Locke, Galileo, and other leaders of thought are studied.

The students are thus led to consideration of important problems which, despite their age and the thought expended upon them, have not yet reached final solution. Students are also acquainted with the works of original authors themselves, and they read books written during the period about which they study.

In such a course the students meet a few of the "great books" and come into contact with problems of the past which have their modern counterpart even today; hence the student comes face to face with problems he will encounter when he graduates. In such a course the hope is to arouse interest in literature, music, history, economics, the arts, labor relations, political science, psychology, and similar broad topics.

All this is not possible without a scholarly and specialized Faculty and this is perhaps the greatest one of the great differences between the School of Humanities and the General Studies program of former years. Dean Buchard said he was not afraid to make a comparison between members of his Faculty and any comparable young faculty in the country. Already many members of this Faculty in the School of Humanities have made outstanding contributions in writing, editing, or in studies of their own. The Center for International Studies and the Graduate Program in Economics are specialized branches of the work in the School of Humanities.

Dean Burchard then outlined the new Course XXI which was initiated at M.I.T. last year. This is similar to the present Course XIV, in which 45 per cent of the student's time is devoted to topics in the humanities, and 55 per cent is devoted to topics in science and engineering. The student is able to obtain a bachelor's degree without course specification in four years, and by taking an additional year of study, is able to obtain a bachelor's degree with course specification. The four-year course may be a terminal course; if it is, it provides a good general education with sufficient engineering and science to enable the graduate to take an intelligent and active part in the mature life in his community. Or, the course may be used as a foundation for advanced work in graduate professional schools, such as medicine, law, business administration, industrial management, and possibly even the ministry. The course has sufficient foundation in science and engineering that it can well serve the needs, at the undergraduate level, of engineers and scientists who continue their graduate work, either at M.I.T. or at similar educational institutes.

Luncheon

At 12:15 P.M. on Friday, those attending the conference had an informal luncheon in the dormitories in the vicinity of the Kresge Auditorium. Some members went to Baker House, where they had opportunity to see dining facilities serving about 350 of the Institute's undergraduate body; others went to the Campus Room in the Graduate House, where they obtained firsthand the opportunity of learning how 450 graduate students regale themselves during the school year.

Effective Teaching and Research

On Friday afternoon Alumni gathered in Huntington Hall – in which many of them had sat as students – to participate in a conference symposium on "Research Progress at M.I.T." C. Richard Soderberg, '20, Dean of the School of Engineering, presided at this meeting at which addresses were given by: Henry G. Houghton, '27, Head of the Department of Meteorology; Thomas H. Pigford, '48, Associate Professor of Nuclear Engineering, and Leonard A. Gould, '48, Assistant Professor of Electrical Engineering.

In opening the afternoon session, Dean Soderberg said:

> I deeply appreciate the privilege of appearing before you on this occasion, particularly because it gives me an opportunity to express my gratitude to you for your unselfish service in furthering the interests of M.I.T. This afternoon's program is devoted to "Research Progress at M.I.T.," and we will endeavor to give you a few samples

Members of the M.I.T. Family at the head table at the dinner in Walker Memorial included (left to right): Donald P. Severance, '38, Secretary-Treasurer of the Alumni Association; Beverly Dudley, '35, Editor, The Technology Review; Henry B. Kane, '24, Director of the Alumni Fund; Theodore T. Miller, '22, Chairman of the Alumni Fund Board; C. Richard Soderberg, '20, Dean of the School of Engineering; Edward L. Cochrane, '20, Vice-president for Industrial and Governmental Relations; John J. Wilson, '29, Vice-president of the Alumni Association; and James R. Killian, Jr., '26, President of M.I.T.

of this side of the Institute's activities. Many of you received your impressions of M.I.T. at a time when research was still somewhat of a side issue, and the role of research in the operations of M.I.T. today is perhaps not always obvious. For this reason, I should like to make a few observations on the role which research plays in our educational program.

The earlier concept of professional education was the transmission to the students of a quantity of information, taken from a stationary and stable body of professional and scientific knowledge. This concept was carried over from the old pupilage system, which was the basis of vocational training. M.I.T. was one of the pathfinders in extending this system to a body of scientific, as well as practical, information. As the body of knowledge has grown and the development of new fields has taken place, this system has shown certain weaknesses, which have been the subject of much discussion in recent years. Perhaps the best way to illustrate the problem is the following. The freshman who enters M.I.T. this fall hopefully expects to graduate in 1959; if he goes on to graduate work, he might not be ready to start his career until 1962 or later, particularly if he is to do his stint of military service. He will reach his prime professionally in the 1970's, and with biological luck, he might be around in the year 2000. Long before then it is probable that our industrial system will have been revolutionized by the influence of new ideas now in view, such as atomic power and automation, and by others still hidden.

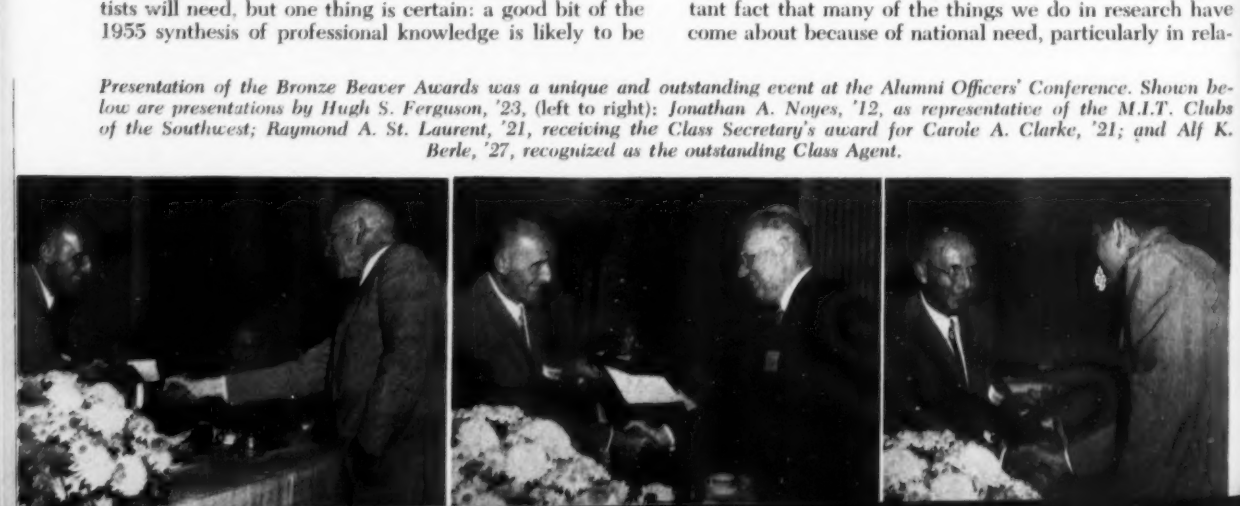
Man usually makes a fool of himself when he insists on predicting the future in detail. We cannot anticipate with any exactitude the things our future engineers and scientists will need, but one thing is certain: a good bit of the 1955 synthesis of professional knowledge is likely to be outdated and irrelevant. This dilemma existed in the past, too, and many of you must have made reflections on the usefulness of the information which you received at M.I.T. One of the reasons why this knowledge has stood you in good stead is that a relatively large segment of it, much larger than that of any other school in fact, consisted of knowledge in fundamental science. This part of the M.I.T. tradition has been further strengthened in recent years, but now even the fundamental sciences present great difficulties in wise selection. Where classical physics was once sufficient, we now have physics of the solid state, quantum physics, relativity, and physics of the atom.

Perhaps the most important conviction which has grown upon us in trying to cope with this situation is that the actual coverage of the educational program is less important than the spirit and methods of reasoning which it embodies. The only part of the training which is likely to survive in the future is the courage and ability to face every new situation requiring lifelong study of new phenomena. This is the very opposite of the comfortable assurance that there is a delimitable quantity of knowledge, forming a permanent set of tools for the professional man.

It is against this background that you should judge the research program of the Institute. Vital teaching stems from participation of both student and teacher in creative, exhilarating effort. This is particularly true for education at the advanced level, but we are beginning to find that the same is true and possible of application at the elementary level as well.

I have left out of this picture the obvious and important fact that many of the things we do in research have come about because of national need, particularly in rela-

Presentation of the Bronze Beaver Awards was a unique and outstanding event at the Alumni Officers' Conference. Shown below are presentations by Hugh S. Ferguson, '23, (left to right): Jonathan A. Noyes, '12, as representative of the M.I.T. Clubs of the Southwest; Raymond A. St. Laurent, '21, receiving the Class Secretary's award for Carole A. Clarke, '21; and Alf K. Berle, '27, recognized as the outstanding Class Agent.



Others at the head table at Walker Memorial included (left to right): Dwight C. Arnold, '27, President of the Alumni Association; George R. Harrison, Dean of the School of Science; Joseph J. Snyder, 2-44, M.I.T. Treasurer; Hugh S. Ferguson, '23, Past President of the Alumni Association; E. P. Brooks, '17, Dean of the School of Industrial Management; H. E. Lobdell, '17, Executive Vice-president of the Alumni Association; Ralph T. Jope, '28, Business Manager, The Technology Review; Bruce F. Kingsbury, '44, Executive Secretary of Educational Council; and John W. Sheetz, 3d, '42, Assistant Director of General Services.

tion to defense. Some of these aspects have forced us to expand the research program beyond the needs of education. I wish to assure you that this is carefully watched by the Administration. Some of these efforts have now been segregated within the Division of Defense Laboratories.

However, the real test of the research program at M.I.T. continues to be its relation to the program of education. The three examples selected for this afternoon's program will illustrate to what extent we have succeeded in this endeavor.

Radar and the Weather

Following Dean Soderberg's remarks, Professor Houghton spoke on "Radar and the Weather" which The Review is pleased to present as a feature article (page 18) in this issue. At the conclusion of his address, Professor Houghton showed motion pictures of the progress of rainstorms in the Boston area, as they were recorded by radar equipment.

Second topic of the afternoon session, emphasizing Research Progress at M.I.T., was an address on "Production and Utilization of Nuclear Power and Progress on the Institute's Reactor," by Professor Pigford.

Nuclear Science and Engineering

A course on "Applications of Engineering of Nuclear Science," which has been offered at the Institute for several years, has presented a sound program in the principles of nuclear reactors, but there is now a demand to give increased attention to the engineering problems of nuclear reactor design, construction, and operation. The national government is committed to a program of fostering nuclear energy for industrial use, and industry is willing to make substantial investment in this field. By 1970, Professor Pigford estimated, seven billion dollars will be spent in the development of nuclear power.

The growth of M.I.T. courses in nuclear engineering and science reflects the increase of general interest in this new field. In 1952 M.I.T. had six undergraduate students in this field; today there are 18 students working toward their master's degrees in nuclear science and engineering, and a program leading to a doctor's degree will soon be operating.

The aim of M.I.T. training in the field of nuclear science and engineering is to draw on the basic undergraduate training in any and all fields of engineering offered at the Institute, and to provide additional courses in nuclear science and engineering such as will make the student a better engineer in the new field of power. Hence, the instruction in nuclear science and engineering draws upon, and builds on, and cuts across existing service courses in all fields of engineering offered at M.I.T. In addition the Department of Chemical Engineering also offers undergraduate service courses in nuclear science and engineering; these are open to all qualified students, regardless of nationality. Of course, the work offered at M.I.T. at the undergraduate level is not classified. Both classified and unclassified work are available, however, in the field of graduate research.

Located at strategic industrial centers in various parts of the nation, the Practice Schools of the Department of Chemical Engineering provide an excellent opportunity for graduate students to put theory to test in actual plant operations. At the Institute itself, however, there is a growing need for students to have an opportunity to test the nuclear theories and textbook material through actual contact, on an experimental basis, with a nuclear reactor. Hence, there is a definite and growing need for a nuclear reactor to be located in Cambridge. Such a reactor is now being planned and will be designed and built primarily for educational purposes. The proposed M.I.T. reactor will not be designed to produce power; in fact, the power it does generate will be wasted, since it is not feasible to build a reactor which serves equally well the needs of classroom or laboratory while also producing useful power.

The nuclear reactor being planned for construction at M.I.T. will be an educational tool broad enough in its capabilities to serve the needs of courses in engineering and science other than those devoted exclusively to nuclear energy. For example, the reactor will provide a copious supply of neutrons, which are useful to all Departments conducting experimental research in the physical sciences.

Head table guests at the Faculty Club on September 10 were (left to right): William Speer, Associate Dean of Students; B. Alden Thresher, '20, Director of Admissions; Norman C. Dahl, '52, Associate Professor of Mechanical Engineering; Dwight C. Arnold, '27, President, Alumni Association; Edward L. Cochrane, '20, M.I.T. Vice-president; John J. Wilson, '29, Vice-president, Alumni Association; President James R. Killian, Jr., '26, Chenery Salmon, '26, member, Executive Committee, Alumni Association; Thomas P. Pitré, Associate Dean of Students; and Gilbert M. Roddy, '31, Vice-president, Alumni Association.

Design plans for the M.I.T. reactor call for a new type of reactor well suited to the needs of educational institutions. The reactor will yield a wide variety of nuclear particles suitable for research needs. Above all, it will be the safest type of reactor now known. Preliminary plans for the reactor have been approved by the Atomic Energy Commission, and improved modifications, now being designed, will be submitted to the A.E.C. for approval before construction is begun. Both the A.E.C. and M.I.T. clearly recognize their obligation to take every known precaution for safe operation of a nuclear reactor to be located in a densely populated industrial area. It is expected that the reactor can be put into operation about the spring of 1958.

The operation of a nuclear reactor which is situated in a metropolitan region raises a number of important problems regarding health. It has already been stated that the type of reactor being built is the safest type now known. The problem of waste disposal, however, remains. The Institute does not propose to handle the problem of radioactive waste disposal by itself. Instead, it plans to collect all radioactive waste products in sealed, steel containers, and ship them to the Atomic Energy Commission for disposal in accordance with procedures set up by this national Commission. So far as potential health hazards are concerned, all operations will be in accordance with A.E.C. requirements, in addition to requirements of the Institute's own personnel in the Medical Department concerned with occupational safety, under the direction of Dr. Harriet L. Hardy.

Feedback and Control

Third and final speaker in the afternoon session on "Research Progress at M.I.T." was Professor Gould who spoke on "Servomechanisms and Automation."

Professor Gould opened his talk with a demonstration in which the motion of an artificial car or "bug" was remotely controlled by light shining on photoelectric cells placed at the eyes of the bug. The principle demonstrated in this rather elementary mechanism was simply that it was possible to design a mechanism that would tend to move toward the brightest light. Of course other control systems are possible, and the demonstration was used solely for purpose of illustration.

(Continued on page 42)

Speakers at the Alumni Officers' Conference on September 10 were (left to right): *Edward L. Cochrane, '20, M.I.T. Vice-president; Herbert S. Amster, '56, chairman of the Dormitory Council; George W. Luhrmann, '56, chairman of the Interfraternity Conference; and John S. Saloma, 3d, '56, chairman of the Institute Committee.*

An Evaluation of Student Government

Those attending the Alumni Officers' Conference Heard the President of the Institute Committee Report on Student Government in the Colleges

By JOHN S. SALOMA, 3d

At the fifth National Student Body Presidents' Conference, held at the University of Minnesota in August, over 200 leaders of student government from every part of the United States were asked a rather searching question: "Can student government justify its own existence?" The results of a Ford Foundation research project – The Role of Student Government in Higher Education – carried out by the United States National Student Association were presented. The study revealed that a large number of student governments were glorified activities boards. Election to some of the representative type student governments had degenerated to a campus-wide popularity contest. Adverse faculty opinion to student government was evident at several schools, where the extracurricular was viewed to be in conflict with the curricular. Not only was faculty and administration support lacking but the students themselves viewed their elected representatives as petty politicians meddling in petty politics. In fact, the problems that ranked highest on most student government agenda were social policies, activities' fees, and traffic parking problems. Few student governments had defined, let alone were aware of, their aims and purposes in the academic community.

We have seen the black side of the picture; now let us look at what might be considered an ideal form of student government. Just what are its characteristics?

First: It has defined its purposes in the educational community. It recognizes the development of the mind as the common bond of the students it represents. Its pursuits are tempered by this realization. Such problems as segregation and limited school facilities, which restrict the development of the individual student, are important concerns of such a student government.

Second: It has a permanency, a maturity that transcends the transitory nature of the four-year student which comprises it. There is a purposeful continuity in its organization and its leadership training programs. It has developed a long-range outlook to provide a balance to the impetuous urge of the student to do something and to do it today.

Third: It assumes a responsible position in the academic community. It works in a spirit of partnership with the faculty and administration. It tackles such problems as college policies on curricula, the location of buildings on campus, tuition changes, student loan policies, vocational guidance, commuter problems, and even college placement. The faculty and administration respect the well-prepared mature opinions of such a student government and look to it for its share of contributions to the growth and improvement of the institution. It is in such activity that student government demonstrates its concern for the advancement and growth of the educational community.

Fourth: It develops horizons broader than its own campus. Problems of national and international scope which concern students in their role as students are evaluated and dealt with individually. The student body is kept aware of major issues, such as military man power and foreign student exchange. An awareness and responsibility that extends beyond the campus is a necessity to the development of the mind.

Fifth: The last and perhaps most idealistic characteristic of our student government is the individual student identifying himself with his student government. When a student government forgets the popular topics of big dances and more space for parking, and begins to work in the more unpopular field of education and the development of the mind, it will find, over the long run, much greater student support. The student from India, the commuter from Dorchester, the dormitory man from Baker, and the fraternity man from Beacon Street will have a common interest in the student government working for the common good.

Well, these are the attributes. The Ford study showed that the majority of American student governments measured up to this ideal miserably. What about M.I.T.? Five years ago I am afraid we would have struck out on all five points! But, fortunately, student government at M.I.T. has made some encouraging strides since then. One of the major accomplishments of this period has been the complete reorganization of student government at the Institute Committee level and the consequent redefining of subcommittee areas. During my freshman and sophomore years, the Institute Committee was an unwieldy group of some 40-odd members, including a large block of activity representatives. After a lot of hard work and some bitter opposition we now have a 19-member Institute Committee with predominantly living group and class representation. The activities have a separate council, subordinate to Institute Committee, and elect a chairman who has one vote in the parent organization. The new streamlined Institute Committee has pledged in the preamble to its constitution to "work for the good, welfare, and renown of the Massachusetts Institute of Technology."

But before I go any further into a description of student government and its activities at M.I.T., I should like to offer an answer to the question that introduced my remarks – "Can student government justify its existence?"

I feel the basis for our concept of student government at M.I.T. is adequately expressed in the words of the late Karl T. Compton:* "Only a part of a really adequate college education is secured in the classroom – a very important part to be sure, but often wasted unless accompanied by qualities of character which are largely the products of personal contacts in the activities of community life. Consequently, I believe that students in a college should be considered not as youths studying and reciting under the discipline of a faculty, but rather as young citizens in a community – a community centered around the intellectual pursuits but involving the responsibilities incident to the social recreational and professional interests of the group. . . . In addition to the influence which comes from the personality and example of teachers, much can be done by suitable organization. For example, the students' extracurricular activities offer a rich opportunity for the development of a sense of responsibility, a technique of mangement, and a spirit of team play."

Dr. Compton's words express the trend in educational circles toward the reintegration of curriculum and extracurriculum leading to the new term "co-curriculum."

I should now like to show you through the work of Student Government, over the past year or two, a few of the contributions it has made to the educational community.

1. Leadership experience is one quality that cannot adequately be taught in the classroom. Through student government individuals are given the opportunity to lead committee meetings or discussion groups, plan and organize small- and large-scale projects from a seminar to an intercollegiate conference, become acquainted with members of the faculty and administration, and speak before groups of students. E. P. Brooks, '17, Dean of the School of Industrial Management, has often referred to student government as a workshop for management. Unfortunately everyone cannot be a chief, we need some Indians. It is still our concern, though, to see that the opportunities for leadership training are maximized.

2. Student-Faculty Administration relations are the crux to the concept of an educational community. I feel the last year has been the most productive in this field. The revitalization of the Student Faculty Committee into a high level Liaison Council and a Student Committee on Educational Policy, roughly paralleling the Faculty Committee on Undergraduate Policy, will greatly facilitate communications and develop a feeling of community co-operation in tackling Institute-wide problems. Several special committees of the Institute during the past year have included both students and faculty. President Killian's Committee on Student Housing, including representatives of the Corporation, Alumni, Administration, Faculty, Graduates, and Undergraduates, will formulate recommendations for the projected development of the Institute over the next decade. Indeed, we have seen a growing community spirit centered around the intellectual pursuits, as Dr. Compton phrased it. But we have not reached Utopia yet. When the Faculty turned down the Institute Committee request to sit in an advisory nonvoting capacity on a number of faculty committees, one of the reasons given was that students lacked "responsibility," – responsibility in the sense of a long-range, more permanent perspective of the Institute and how it operates – a responsibility seasoned by years of experience. In the eyes of our faculty, student government has a long way to go in demonstrating the permanency and responsibility of the ideal I referred to earlier. The burden of proof must rest with us. The success or failure of the student venture on educational policy will have important repercussions on faculty thinking. It is my sincere hope that some day in the not too distant future, we shall progress to the point where the faculty will invite students to sit in regular attendance on whatever standing committees may be concerned with the role of the student in the academic community.

3. If any contribution to Institute thinking can be labeled of student origin, the proposal for a Student Union Building is it. The idea of a student center had its beginning years ago at the Institute. But for years it was only an idea, a rather unimportant one on the over-all building program of the Institute. The Baker Memorial Committee undertook a study of a student center at M.I.T. The project grew and a special subcommittee of the Institute Committee was formed. That was two years ago. The students have since presented to the President and Corporation a well-formulated report on a Student Alumni Center at M.I.T. The report embodies the purpose of, and need for, a Center, facilities which should be included – for activities and organizations, recreation and commercial establishments – student surveys, financial estimates, a tentative location plan and tentative architectural plans. Three student theses have been written on the subject. The original concept of a student union has broadened to one of a true center of campus activities, with hotel and restaurant facilities for visitors, and a location for alumni functions and offices.

The need for such a building has been recognized by the Institute. In a few months, when the recommendations of the Committee on Student Housing are presented to the President, we shall have a better idea as to its status on the building program. Further planning on an Institute level will then be necessary. We hope that in the not too distant future the entire Institute will benefit from the idea pioneered by the students.

You have already heard of the successful conference on "Selectivity and Discrimination in American Universities." Many of you have read the Compton Book, or seen the activities calendar. These are a few other contributions of student government to the educational community. If time permitted I should like to go into areas of current concern to student government – the problems of commuters and foreign students.

(Concluded on page 70)

* President of M.I.T., 1930–1949.

Our Man Power Resources

President Killian's Annual Message to the Corporation Emphasizes the Institute's Responsibility to Educate the Nation's Leaders

M.I.T. Photo

President Killian in Walker Memorial, as he appeared before the Alumni Officers' Conference on September 9.

In his annual message to the M.I.T. Corporation, on October 3, James R. Killian, Jr., '26, President, reporting on the state of M.I.T., dealt effectively with a discussion of the nation's man-power requirements and especially with the Institute's response to these requirements. A wealth of information on the nation's current man-power requirements in the field of technology is contained in Dr. Killian's report which Alumni will want to read. In resuming publication after the summer vacation period, The Review is faced with an unusually large amount of news to report, and rather definite limitations of time and space in which to set forth an adequate review of activity that has taken place since the July issue was published. For this reason, President Killian's annual message is presented in condensed or abbreviated form in these pages.

In the opening section entitled "Meeting the Nation's Scientific Man Power Needs," President Killian said:

> The strategical planning of our man-power resources in the United States calls at this juncture for a major drive to enhance the excellence and increase the creativity of scientific and engineering education even beyond their present fine performance. The strength and progress of our society depends less upon numbers and more upon an advancing quality of professional accomplishment. Technological competition among nations and among industries is increasing, and the safety and welfare of both may depend upon their capacity to compete. Our dynamic society anticipates and requires new jobs, an upgrading of old jobs, a still higher standard of living, better health, and stronger defense. The fulfillment of these needs requires a new order of excellence and creativity in the nation's professional work. While the preparation for this new order of excellence begins in the secondary schools, our professional schools have the major responsibility in setting and underwriting these new standards of professional accomplishment.
>
> While the United States has experienced shortages of professional talent in the past, notably of physicians, we have not in many years experienced so great or persistent an imbalance between supply and demand as we now have in science and engineering. The sustained scarcity of professional man power in these fields, having been widely proclaimed, is now generally recognized, and its handicap to the nation is becoming understood.
>
> Not so well recognized and understood or stressed is the qualitative nature of the shortage. We have a shortage of young engineers competent to handle new, advanced technologies. We have a shortage of research scientists and engineers (the demand for whom has been doubling every decade). We have an acute shortage of scientists whose creative and conceptualizing powers are exceptional. We have, in summary, a shortage more of basically educated, versatile young talent than of mere numbers of scientists and engineers. There is indeed a shortage of numbers in many but not all fields of science and engineering; we could better cope with such a shortage did we not also have an even more severe shortage of quality, depth, adaptability, and up-to-dateness.
>
> As our advancing technology becomes more complex and sophisticated, it requires scientists and engineers – and managers – of more advanced education and analytical powers. There are areas of technology so new and rapidly advancing that only men with self-acquired fundamental and versatile understanding or with recent education in the new technologies are able to master or to keep pace with them. There are many areas of technology that are now closed books to those engineers lacking creative powers or to those whose training or analytical abilities never carried them beyond the superficial methods of handbook engineering. The qualitative nature of this scarcity is reflected in the placement offices where industry seeks new men. Employers are not just looking for "bodies" with degrees; they are looking with a critical eye for competence that is up-to-date and versatile enough to meet the needs of their advancing technology. The companies dependent upon "high" technology are pressing the colleges for men with a more fundamental, integrated education in science, engineering, and the humanities rather than for men specialized in some field of technology at the expense of fundamentals. Employers want more scientists and engineers,

but they don't feel they are meeting their needs by employing inferior or narrowly educated ones. They want men – particularly young engineers – with the power to deal with the technologies of tomorrow and not of yesterday.

Similarly in the basic sciences our most pressing needs are for those scientists who have the imagination and trained creative power to make the discoveries and generate the new concepts which advance science. We hear much about the need for basic research and funds to support it. These needs are great, but greater still is the need for more scientists who have the trained talent, the motivation, and the conceptualizing power to make basic research really basic. In stressing the need – which has always been present – of exceptional talent, I do not minimize the critical shortage of the rank and file of good competent scientists. Flag officers are not enough to provide a strong scientific attack force, but the really acute shortage now is in the flag officer group. . . .

Having thus stated the qualitative aspects of the present scarcity of technical man power in the United States, President Killian gave consideration to those factors affecting the quality and intellectual abilities of technically trained personnel of the highest caliber. It is especially in this area that M.I.T. is most concerned and can make its greatest contribution to national welfare. This was clearly recognized in the President's Report when Dr. Killian said:

The quality of American scientists and engineers depends upon our willingness and success in building a more differentiated system of higher education, with institutions specialized more and more in accord with the degree of intellectual performance expected of their students. It depends, for example, on increasingly strong graduate schools of science and engineering and on undergraduate schools associated with these graduate schools where standards of admission are very high and where the educational environment is as benign to scholarship and discovery as that to be found anywhere in any field of learning. These are qualities of maturity, of disinterested scholarship, of freedom, and of intellectual stimulus which mark such an environment and which are necessary for scientific work of the highest order and for the maturing of first-rate scientists and engineers.

One of the major threats to scientific and engineering education is the higher compensation and other attractions offered to scientists and engineers by industry and other employers. This problem is less acute in science, since the university is (and must continue to be) a natural habitat for creative scientists. Engineering education, however, has been more vulnerable to this competition. This is particularly true of those engineering schools limited to undergraduate programs; but all of engineering education has been under pressure because its young and imaginative teachers – especially those in the advancing, growing fields of technology – are sought after by industry to a greater degree than any other group in our educational institutions.

If engineering education is to meet this challenge and prevent the spreading scarcity of quality in engineering schools that has weakened science teaching in the high schools, it must find ways to make engineering schools a more attractive environment for top-flight engineers.

One of the surest ways of accomplishing this is to create and maintain strong graduate schools of engineering. In those engineering institutions where strong graduate schools exist and where there is a fruitful alliance with basic science, an environment attractive to first-rate engineers has been achieved – but not, of course, a competitive scale of compensation. The urgent need now in American engineering education is for more research and graduate study in order to create the environment for attracting first-rate, imaginative teachers. The engineering profession can no longer depend primarily upon a system of undergraduate professional education. The development of more advanced study is the path that can lead again to creativeness and imaginativeness in teaching – that boldness and fecundity in pioneering new educational ideas that have characterized engineering education in the past and that it now seems to have lost. It is not that our national resource of engineering education is less strong than it used to be. It is rather that the demands placed by our society on engineering education are greater. The challenge of this responsibility and of our advancing technology steadily creates new opportunities and new requirements for engineering education and creates the need for a new order of professional excellence. We have a small number of engineering institutions – and M.I.T. is one of these – where this awareness of the engineer's new importance in our society exists, and where there is an atmosphere of creativity, of growth in ideas, and of high professional excellence that are commensurate with the responsibility and potential of engineering in our society. These institutions, however strong, cannot relax for a minute if they are to keep ahead of our society's advancing technological opportunities and if they are to educate engineers of the breadth, scope, and power now needed. . . .

With this outline of the nation's present need for broadly trained scientists and engineers of the highest professional competence, President Killian next devoted a section of his annual report to a review of the Institute's response to an important national need and its unique responsibilities in helping to alleviate the man power shortage. He recalled, for example, that the Institute's enrollment has increased by 2,600 students (or by 80 per cent) since 1941, while new buildings costing $18,878,000 and permanent funds totaling $28,733,000 have also been part of the Institute's postwar program. President Killian outlined methods the Institute is taking to minimize human wastage, by better procedures for selection of students and by reducing the number of failures for reasons of low scholarship. The Institute's program of student selection was also discussed in detail at the Alumni Officers' Conference which was held at M.I.T. on September 9 and 10, a report of which appears in this issue of The Review. In addition, Dr. Killian recalled that:

M.I.T. has shared in meeting the national need by initiating new programs to meet new needs, both in research and in teaching. Since the war we have added a graduate course in nuclear engineering and augmented our program in nuclear science. We have organized a School of Industrial Management, established as a formal entity the School of Humanities and Social Studies, and added the Center for International Studies. To recognize new areas of importance and new technologies and to increase opportunities for both graduate and undergraduate study, we have organized new laboratories and programs such as the Research Laboratory of Electronics; the Combustion, Acoustics, Nuclear Science, Gas Turbine, Servomechanisms, Dynamic Analysis and Control, Instrumentation, Cryogenic, Insulation Research, Hydrodynamics, and Aero-Elastic Laboratories; the Supersonic Wind Tunnel and the Towing Tank. There has been an

(Continued on page 66)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Atoms for Peace Awards

JAMES R. KILLIAN, JR., '26, President of M.I.T., will serve as chairman of the Organization and Planning Committee of Atoms for Peace Awards, according to an announcement late in September made by Henry Ford, 2d. In addition to Dr. Killian, the committee will include: Detlev W. Bronk, President of the Rockefeller Institute for Medical Research and President of the National Academy of Sciences; Ralph J. Bunche, Under Secretary General of the United Nations; Arthur H. Compton, professor, and former Chancellor, Washington University; Mrs. Douglas Horton formerly President of Wellesley College; Mervin J. Kelly, President of the Bell Telephone Laboratories; and Alan Waterman, Director of the National Science Foundation.

Atoms for Peace Awards, announced by Lewis Strauss, chairman of the Atomic Energy Commission, in Geneva on August 8, was established as a memorial to Henry Ford and Edsel B. Ford by a Ford Motor Company Fund appropriation of $1,000,000. It will provide $100,000 annually for 10 years to be spent in helping to provide incentives for the world's scientists, inventors, and engineers – without regard for nationality or political belief – toward finding new ways in which the atomic energy science can be used for the welfare of mankind.

"I welcome the opportunity to share in the establishment by Mr. Ford of the Atoms for Peace Awards and to work with him and the other members of the committee in planning the means for making the awards," Dr. Killian commented. Continuing, he said: "Bold and imaginative acts to encourage and demonstrate the benign uses of science and technology, such as the president's 'Atoms for Peace' program, are top-priority items on the agenda for world peace. The establishment of the Ford Atoms for Peace Awards is such a bold and imaginative act, and I am happy to be associated with the program."

Mr. Ford said that the Executive Committee of M.I.T. had approved his suggestion that the headquarters of the new institution be located at the Institute. The Organization and Planning Committee, under the leadership of Dr. Killian, has agreed to undertake the planning and organization of the Atoms for Peace Awards that will best assure the use of its funds during the next 10 years toward the application of atomic energy for man's benefit.

In inviting Dr. Killian and the six distinguished members of his committee to accept this assignment, Mr. Ford expressed the hope that the committee "would set up the organization of the awards so that the organization would be an independent corporate entity, entirely separate and divorced from Ford Motor Company."

In informing Lewis Strauss of the establishment of the new institution on July 25, Mr. Ford described it as a response to the hope expressed by President Eisenhower at the July meeting of the "Big-Four" in Geneva that "private business and professional men throughout the world will . . . provide an incentive in finding new ways that this science can be used . . . for benefit of mankind and not for destruction."

Mr. Ford said at that time, "We would propose that when the organization of this new memorial fund is completed, the Board of Trustees of Atoms for Peace Awards appoint each year a competent International Jury of Awards for the purpose of selecting from among the world's scientists, inventors, and engineers –without regard for nationality or political belief – the individual or group of individuals who, in the jury's judgement has made the greatest contribution during the year to peaceful uses of atomic energy; that the individual or group so selected be granted with appropriate ceremony the Atoms for Peace Award for that year; that the annual award carry, in addition to a suitable medal to be designed and cast for the purpose, an honorarium of $75,000; that, if during any year the International Jury of Awards or the Board of Trustees finds no candidates preeminently meriting the Atoms for Peace Award, the sum at the disposal of the memorial fund be used that year for scholarships and fellowships most likely to contribute to the advancement of the new science of peaceful application of atomic energy."

Institute Professor

APPOINTMENT of Francis O. Schmitt as an Institute Professor at M.I.T. was announced in September by George R. Harrison, Dean of the School of Science. Dr. Schmitt becomes the second Institute Professor at M.I.T., a distinguished academic post which recognizes outstanding achievement and gives its incumbent freedom to concentrate on research and advanced teaching. The only other member of the Institute's Faculty who holds this rank at present is Professor John C. Slater, distinguished solid state physicist.

For the past 14 years Dr. Schmitt has been head of the Department of Biology. Under his leadership, the Department won international recognition and Dr. Schmitt has requested that he now be freed from administrative duties to devote all his attention to advanced teaching and research. Irwin W. Sizer, Associate Professor of Biochemistry, who has been the Biology Department's executive officer, has been appointed acting head of the Department. Dr. Sizer has taught physiology and biochemistry at the Institute for 20 years. In addition he has had considerable experience as an administrator and has for many years been in charge of the program for biology graduate students.

Dr. Schmitt is one of the world's foremost authorities on the biological uses of the electron microscope, which has made possible in recent years the photog-

Members of the Class of 1930 and their families happily celebrated their 25th reunion on the week end of June 10. Baker House at M.I.T. served as headquarters.

raphy and study of structures approaching the molecule in size. He came to M.I.T. in 1941, the year in which the Institute installed the first electron microscope used in an academic biological laboratory. M.I.T. now has six electron microscopes in operation.

A native of St. Louis, Dr. Schmitt received his A.B. in 1924 and Ph.D. in 1927 at Washington University. As a student he became interested in x-ray diffraction and polarization optics which, along with the more recently developed electron microscope, make possible the study of the molecular organization of cells.

Dr. Schmitt did advanced study at the University of California, University College in London, and Kaiser Wilhelm Institute of Berlin-Dahlem. In 1929 he was appointed to the faculty of Washington University and was head of the department of zoology there when he left to come to M.I.T. He is currently making studies of collagen, the primary protein of skin and connective tissue, in connection with rheumatoid arthritis and the tanning of leather. His work has included the photographing of macromolecules, only one one-hundred-thousandths of an inch long, which are produced by cells as basic biological building blocks, just as girders are produced by the steel industry for the basic components of buildings.

Dr. Schmitt was awarded the honorary degree of doctor of science by Johns Hopkins University in 1950 and Washington University in 1952. He is chairman of the Study Section on Biophysics and Biophysical Chemistry for the National Institutes of Health. He is a member of the National Academy of Sciences, the American Philosophical Society, the American Physiological Society, the Society for Experimental Biology and Medicine, the American Society of Zoologists, the American Society of Naturalists, the Electron Microscope Society of America, and the Crystallographic Society. He is also a fellow of the American Academy of Arts and Sciences and the New York Academy of Sciences.

Dr. Sizer, a native of Bridgewater, Mass., received his A.B. from Brown University in 1931 and his Ph.D. from Rutgers University in 1935. He came to M.I.T. in 1935 as instructor and research associate in biology and public health, became an associate professor in 1942 and executive officer of the Department in 1954. In 1951 he was a visiting lecturer at Brown University where he taught a seminar course on enzymes.

Dr. Sizer has worked on the spectroscopy and biochemistry of collagen and has done research in connection with the use of sheep gut, of which collagen is the principal constituent, for surgical sutures. His special interest has been the study of enzymes, such as tyrosinase, which is responsible for the pigmentation of the skin. In addition he has studied extensively enzymes which are concerned with the clotting of blood, and others which bring about the oxidation and destruction of the toxic irritants of poison ivy.

Dr. Sizer is a fellow of the American Academy of Arts and Sciences and a member of the American Society of Biological Chemists and the American Physiological Society. He also holds membership in the American Society of Zoologists.

Foundry Professorship

FOUNDRY work, once regarded as "a low-brow and sooty craft," has progressed in the direction of a science and now has its first professorship. The American Brake Shoe Company Professorship of Foundry Metallurgy, specifically designated for Howard F. Taylor, 2–46, already Professor of Metallurgy and Director of the Institute's Foundry Laboratory, has been established at M.I.T.

In making the announcement, C. Richard Soderberg, '20, Dean of the School of Engineering, said: "The establishment of this chair will stimulate education and research in foundry engineering, a field which only recently has begun to apply the scientific method. It also recognizes the life work of Professor Taylor, who more than any one else, has infused into the field the spirit of scientific methods and research.

"Metal casting is one of the oldest of the crafts but for centuries it was done chiefly by trial, error, and tradition. The American Brake Shoe Company and M.I.T. were among the pioneers in applying to it the principles of engineering."

Professor Taylor began his career in Navy research. A native of Leslie, Mich., he was graduated from Michigan State College with degrees in chemical engineering and metallurgical engineering. After a year as an instructor there, he went to the Naval Research Laboratory in Washington in 1937 and later became head of Steel Casting Research. He joined the M.I.T. staff in 1945 and in 1952 became a full professor.

Partly in consideration of his work during World War II, Professor Taylor was awarded the Peter L. Simpson Gold Medal in 1946 by the American Foundrymen's Society and the Army-Navy Distinguished Civilian Service Award in 1948.

Du Pont Athletic Bequest

A BEQUEST of $1,000,000 for the improvement of athletic facilities at the Institute was announced by James R. Killian, Jr., '26, President, at a general convocation at M.I.T. on October 3. The bequest was made by a young man who would have been a senior at M.I.T. this fall if he had not been killed in a tragic automobile accident early last month. He was 21-year-old David F. du Pont, '56 (of Wilmington, Del.), a major in Metallurgy at M.I.T. and the son of the late Lammot du Pont, '01, former president and chairman of the board of E. I. du Pont de Nemours and Company, and member of the Institute's Corporation for many years. In announcing the bequest, Dr. Killian said:

"This bequest emphasizes our feeling of tragedy in the loss of David du Pont while at the same time leaving us with a feeling of the deepest appreciation for his generosity, his foresight, and his expression as a student of affection for the Institute."

Dr. Killian indicated that the fund would be used both to maintain the quality of the athletic coaching and teaching staff at the Institute and to provide new or improved athletic facilities. Without detailing specific uses for the large capital fund, Dr. Killian reemphasized the long-standing athletic policy of the Institute.

"This policy," he said, "seeks to maintain an athletic program which will serve our educational objectives and provide wholesome recreation. It will never make athletics an end in itself.

"As in the past," Dr. Killian continued, "we shall encourage a maximum degree of student participation in athletics, promote student responsibility in the management of athletics, and stress intramural sports while maintaining a vigorous but moderate program of intercollegiate competition."

The principal speaker at the convocation, at which Dr. Killian presided, was the Right Honorable Clarence D. Howe, '07, Canada's Minister of Trade and Commerce, and Minister of Defence Production. Mr. Howe is also a member of the M.I.T. Corporation. Other members of the Institute's Corporation attended the convocation as guests of honor.

Other speakers on the program were: Professor Martin J. Buerger, '24, Chairman of the Faculty; Christopher J. Newton, President of the Graduate Student Council; and John S. Saloma, 3d, '56, President of the Institute Committee.

Director of Athletics

RICHARD L. BALCH, formerly dean of men at Stanford University, has been appointed director of athletics at the Institute, succeeding Ivan J. Geiger, who died last January. Roy B. Merritt has been acting director. Dean Balch, 36 years old, was varsity quarterback for three years at Union College and also played lacrosse for three years. He was a PT boat commander during World War II and has been at Stanford University since 1949.

In announcing the appointment, E. Francis Bowditch, Dean of Students, pointed out that M.I.T. has been widely recognized for its athletic program, which encourages participation by many students rather than concentrating on the production of big-time teams.

Said Dean Bowditch, "Athletics broadly conceived, properly administered, and staffed with men of high quality can be one of our most valuable educational tools. Mr. Balch has a broad personal, educational, athletic, and administrative background coupled with unusual skill in working with and inspiring young people."

Mr. Balch was born in Evanston, Ill., but he was reared in Pasadena, Calif. While in Pasadena High School he participated in the sports of boxing, basketball, track, and baseball. He is a golf, tennis, and sailing enthusiast.

After graduation from Union College in 1941, Mr. Balch worked for a time as a claims adjuster for Liberty Mutual Insurance Company in San Francisco, and then volunteered for service in the Navy. He was a personnel and gunnery officer in PT Squadron Eleven from 1942 to 1944, participating in the Guadalcanal, Central Solomon, and Northern Solomon campaigns. He returned to the United States to teach in Motor Torpedo Boot Training School in Rhode Island.

Following the war he returned to Union College as administrative assistant to the president and assistant football and lacrosse coach. As dean of men at Stanford, Mr. Balch has been responsible for general academic and personal advising, supervision of the dormitory staff of men, adviser to fraternities and administration of financial aid.

In his new duties, according to Dean Bowditch, Mr. Balch will not only have charge of the athletic program but will co-ordinate the development of the athletic program with the development of the dormitory, fraternity, and activities programs.

Robert P. Bigelow: 1863–1955

ROBERT P. BIGELOW, Professor of Zoology and Parasitology, Emeritus, who retired in 1933 after 40 years' service in the Institute's Biology Department died on Tuesday, September 6. He was 92 years old. A native of Baldwinsville, N.Y., Dr. Bigelow was graduated from Harvard University and received the degree of doctor of philosophy at Johns Hopkins University before joining the Institute staff in 1893 as an instructor. He was appointed assistant professor of zoology and parasitology in 1912, associate professor in 1915, and professor in 1922. Following his retirement, Dr. Bigelow served as honorary lecturer in the Biology Department; and, in 1944, returned as a special lecturer. He had been librarian of the Institute from 1895 to 1925.

Dr. Bigelow was also the former librarian of the Marine Biological Laboratory at Woods Hole, and editor of the *American Naturalist* and *Technology Quarterly*. He was author of numerous articles on zoology and biology, and since his retirement had been occupied with historical writings and scientific reviewing. A fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science, he had held memberships in the American Society of Naturalists, Association of American Anatomists, and History of Science Society.

In celebration of their 45th anniversary since graduation from the Institute, the Class of 1910 held its reunion at the Chatham Bars Inn, Cape Cod, on June 10 to 12. Despite rainy and cold weather, the spirit of those assembled was warmed by the friendship of half a century of association. In usual reading order are: Harold C. Manson (standing), Herbert S. Cleverdon, John Avery, Clifford C. Hield, Dudley Clapp, and Harold D. Billings. Standing, at right: *Chairman of the 45th reunion, John B. Babcock, 3d, Professor of Railway Engineering, Emeritus. Professor Babcock is also Class Agent for 1910.*

Political Science Section Formed

PROFESSOR NORMAN J. PADELFORD has been appointed chairman of the new Political Science Section at the Institute, according to Julius A. Stratton, '23, Vice-president and Provost of M.I.T. The section, which has been established within the Department of Economics and Social Science, will coordinate the work of professors in several M.I.T. departments for more effective undergraduate instruction in political science. By centralizing a wide range of academic research and teaching in political science, it is hoped that the new Political Science Section will act as a focus for further development of the field at the Institute. The interdepartmental faculty of the Political Science Section already includes two senior professors from other departments of the School of Humanities and Social Studies: Karl W. Deutsch, Professor of History and Political Science, and Walt W. Rostow, Professor of History.

Dr. Padelford, Professor of Political Science in the Department of Economics and Social Science, will hold the rotating chairmanship of the section for the first two-year term. He has been a professor at M.I.T. since 1944, when he inaugurated a senior course in international relations as part of the new Humanities Program.

During World War II, Professor Padelford served as consultant at the Department of State in Washington, where he was intimately connected with the planning of United States policy on the establishment of the United Nations organization and the preparations of peace negotiations. In 1944, he was a member of the United States delegation to the Dumbarton Oaks Conference on International Organization and, as Executive Officer at the San Francisco United Nations Conference, he had charge of the drafting of the statute of the World Court. In addition, Professor Padelford has served as United States Delegate to the London Conference on European Inland Transport, and as adviser to Secretary of State Byrnes at the Council of Foreign Ministers' London meeting on treaties of peace for the Balkan countries.

Regular Chapel Services Inaugurated

THE M.I.T. Chapel, designed to meet the needs of all religious faiths, is one of the few in the country to be used for regular services by Protestants, Catholics, and Jews alike. The United Christian Council at M.I.T. inaugurated regular daily services of morning prayer beginning on September 20.

Over the week end beginning Friday, September 16, Jewish services were held by Rabbi Herman Pollack, adviser to the M.I.T. Hillel Foundation, to usher in Rosh Hashana. Regular Jewish Sabbath and holiday services will be held in the chapel throughout the school year.

Roman Catholic Mass was celebrated for the first time in the chapel on September 20, by Father Edward J. Nugent, chaplain to the Technology Catholic Club. Such services will be held regularly throughout the school year.

The first Greek Orthodox service was held on September 22. Bishop Athenagoras, spiritual leader of the Greek Orthodox Diocese of New England and eastern Canada, officiated. Assisting Bishop Athenagoras in the service were the Very Reverend K. Samaras, Chancellor of the New England Diocese, and Father A. J. Metaxas, rector of St. Constantine Church in Cambridge. Father Metaxas, who is chaplain to Orthodox students at M.I.T., will conduct regular weekly services in the chapel.

The first Episcopal service was held on September 28. The Right Reverend Norman B. Nash, Bishop of the Episcopal Diocese of Massachusetts, was celebrant and the Right Reverend Anson P. Stokes, Jr., Bishop Coadjutor of the Diocese, was preacher. Weekly communion services for Episcopal students will be held on Wednesday afternoons throughout the academic year, and also on the morning of the first Wednesday of every month. Episcopal chaplains to the Institute are the Reverend Peter R. Blynn, assistant priest at the Church of the Advent in Boston, and the Reverend John Crocker, Jr., minister to students at Trinity Church in Boston.

The chapel is a part of a $2,000,000 campus center at M.I.T. which was dedicated last spring.

Consultant to Dean of Students

UNDER a grant from the Fund for the Advancement of Education, Robert S. Hartman, associate professor of philosophy at Ohio State University, has joined the M.I.T. Faculty to serve as consultant to the Dean of Students at the Institute. In announcing the appointment, E. Francis Bowditch, Dean of Students at M.I.T., stressed its relationship to M.I.T.'s educational philosophy.

"In the current evolution of undergraduate education at M.I.T.," said Dean Bowditch, "there has been an increasing concern with value and a deepening concern with the development of the whole man as an integral part of professional education. This precedent-breaking appointment is an example of one of the many ways in which M.I.T. is trying to meet its responsibilities to prepare young men and women to lead and operate the complicated technical society produced by the application of science to the needs of man. It also reveals our recognition of the predicament of modern man in his attempt to find his own self in the complex of social and technological relations.

"While Dr. Hartman is with us we hope also to begin a program which will bring together various groups – Faculty, religious leaders, psychologists, and philosophers – for the discussion and handling of religious and philosophic problems and values at M.I.T."

While at M.I.T. Dr. Hartman will participate personally in the Institute's counseling program and will help the counseling staff analyze problems from the point of view of value theory and practice. He will also aid the Dean's Office in a review of the human and social values of M.I.T.'s current students' activities program. In addition, he will teach two undergraduate courses on value theory in the School of Humanities and Social Studies.

Dr. Hartman's special interest is in the field of ethics – a field which he feels will one day be recognized as a science in itself. He himself has given much of his professional life to developing a system of scientific ethics.

Born and raised in Berlin, Dr. Hartman received the degree of bachelor of laws from the University of Berlin in 1932. Previously he had studied at the German College of Political Science (1926–1927), the University of Paris (1927–1928), and the London School of Economics and Political Science (1928–1929). In 1946 he received the degree of doctor of philosophy from Northwestern University.

He began his professional career as assistant on the faculty of law at the University of Berlin and as assistant judge (referendar) in the Berlin district court in Charlottenburg (1932–1933).

He became a copyright representative for Walt Disney in Sweden, and later in Mexico City, immigrating to the United States in 1941.

From 1942 to 1946 he was a master at Lake Forest Academy and from 1945 to 1948 instructor and then assistant professor at the College of Wooster. He joined the faculty at the University of Ohio as associate professor in 1948. Dr. Hartman has written extensively in theoretical philosophy and in economic and political philosophy, and he is a member of a number of philosophical and educational associations. He has been coeditor of *Kantstudien* since 1952.

Webster Professorship Announced

APPOINTMENT of G. Wesley Dunlap, prominent General Electric Company engineer, as a visiting professor at the Institute has been announced by C. Richard Soderberg, '20, Dean of the School of Engineering. Now manager of the Instrument and Nuclear Radiation Engineering Services Department for General Electric at Schenectady, Dr. Dunlap will be on leave from the company while at M.I.T. during the academic year which began in September.

Dr. Dunlap will be the third distinguished engineer to hold the Edwin Sibley Webster Professorship of Electrical Engineering, established by a $400,000 grant in memory of Mr. Webster, who, with his M.I.T. classmate, Charles A. Stone, founded the consulting firm of Stone and Webster, Inc. Last year the chair was held by Robert A. Ramey, Jr., of Westinghouse Electric Corporation and the previous year the appointee was Professor Arnold Tustin of the University of Birmingham, England.

A native of Nevada, Dr. Dunlap did his undergraduate and graduate work at Stanford University and has been on the General Electric staff since 1936. During World War II he was assigned to Manhattan District and made important contributions to the atomic bomb in connection with the production of Uranium-235. Since the war Dr. Dunlap has participated in the development of such advanced equipment as cyclotrons, synchrotrons, particle accelerators, and radiation and electronic instruments.

Metropolitan

The week end of June 10 also included the celebration of the 30th reunion of the Class of 1925. Headquarters were located at the Hotel Continental in Cambridge.

At M.I.T., according to Professor Gordon S. Brown, '31, Head of the Department of Electrical Engineering, Dr. Dunlap will conduct a graduate course, give formal lectures, and make important contributions through consultation on research and guidance in plans for the Department as they bear on new efforts related to energy conversion and exploration of solid state devices, such as transistors, solar batteries, and magnetic amplifiers.

"We feel that in these times of extremely rapid progress in science it is very important for electrical engineers in academic and industrial fields to exchange ideas," Dr. Brown said. "Our Department of Electrical Engineering has been extensively reorganized in recent years and, especially because of the great shortage of engineers, it is indispensable that we continue to change in order to prepare our graduates to deal with the problems of the future. It will be useful, too, for a ranking member of such a company as General Electric to be in close contact with the basic studies that are being done at M.I.T."

Dr. Dunlap is a fellow of the American Institute of Electrical Engineers, a member of the American Physical Society, and a charter member of the American Nuclear Society. In 1942 he was awarded the Alfred Noble Prize of the American Institute of Electrical Engineers.

Administrative Promotions

ALBERT F. SISE, formerly executive officer of M.I.T.'s Servomechanism Laboratory, has been appointed personnel officer of the Institute, and G. Edward Nealand, '32, formerly manager of the Office of Laboratory Supplies, has become director of purchasing. Announcement of these two administrative promotions at the Institute was made by Joseph J. Snyder, 2–44, Vice-president and Treasurer of the Institute, after publication of the July, 1955, issue of The Review.

As personnel officer, Mr. Sise will be responsible for carrying out the established personnel policies of the Institute. He will be a member of both the Personnel Board and the Personnel Advisory Committee.

As director of purchasing, Mr. Nealand will assist Institute academic departments, administrative offices, and certain sponsored-research projects with their purchasing activities. He will also serve as chairman of a new committee – the Purchasing Council – the membership of which will consist of representatives from central administrative offices of the Division of Industrial Coöperation, the Division of Defense Laboratories, research projects, and laboratories at the Institute.

Mr. Sise is a graduate of the Browne and Nichols School and a member of the Class of 1928 at Harvard. A research associate at Harvard from 1930 to 1932, he did some of the early experimental work on the propagation of ultra high-frequency radio waves. From 1932 to 1942 Mr. Sise served in a number of engineering posts, including that of chief engineer with the Yankee Network. He was responsible for the construction of the Network's radio station on Mount Washington. Since 1942 he has been with the Division of Industrial Coöperation at M.I.T. where during World War II he was a group leader in the Radiation Laboratory. He received a Certificate of Merit for his work on the development of radar. In 1945 he joined the staff of the Servomechanisms Laboratory at M.I.T. where he has been associate director and executive officer.

Mr. Nealand is a graduate of M.I.T., in the Class of 1932. He was with Carter's Ink Company from 1933 to 1946 where he served in the Engineering Department and in an administrative capacity in Personnel Relations and Production. He joined the M.I.T. staff in 1946 as assistant manager of the Division of Laboratory Supplies and became manager of the Division in 1947. A past chairman of the Educational Committee of the National Association of Educational Buyers, Mr. Nealand is secretary of the Boston section of the Association.

Boston Symphony Broadcasts from Kresge Auditorium

HISTORY was made in the field of music and television – to say nothing of the new history that was written at M.I.T. – on October 3 when the Boston Symphony Orchestra, conducted by Charles Munch, broadcast a complete concert from the Kresge Auditorium. The event was the first time the Boston Symphony gave a concert in the Auditorium, and it was the first time that a complete concert by a major concert orchestra was televised in the United States. Berlioz "Fantastic" Symphony, Debussy's "La Mer," and Ravel's "Daphnis et Chloé" could be heard on the frequency modulation channel of WGBH, while television Channel 2 of WGBH-TV brought the orchestra into view for those owning television sets in the general area of Boston. But the 1,200 persons who filled the Auditorium to capacity on this occasion benefited most and heard a concert such as is rarely performed, artistically and acoustically.

A superb performance by Charles Munch contributed to the favorable comments on this occasion, but so, too, did the unusual acoustic properties of the Kresge Auditorium. Speaking of the performance, the *Christian Science Monitor* said, editorially:

> One hears this music as he never heard it before. He enters into a world of sound in much the same way as he would step into a world of crystal. The instruments suddenly come into a vivid focus. The entire orchestra is laid open to the listener, exposed in detail.
>
> It was most fortunate for all concerned that this performance was by an orchestra of the first rank under a conductor like Charles Munch. Any lesser aggregation – any ensemble accustomed to making mistakes – would have been lost, for no mistake can be covered in this hall. The listener would not only perceive the mistake, he would know what instrument made it; and happily one can say that mistakes last night were almost nonexistent.

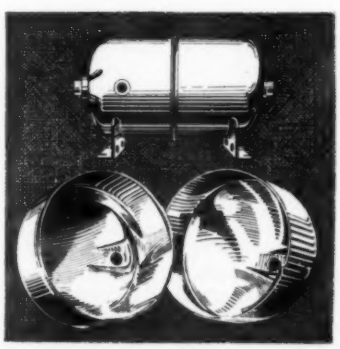
The Boston *Globe* on October 4 commented:

> Last night's program was a demanding workout both for orchestra and for audience. It seemed calculated to test the acoustical properties of the hall. Berlioz "Fantastic" Symphony, Debussy's "La Mer," and Ravel's Second Suite from "Daphnis and Chloë" demand the highest technical expressions from the orchestra. Seldom have musical sounds been heard with such clarity and precision.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Last year a famous manufacturer of domestic refrigerators decided that an automatic juice dispenser would be a desirable feature for special models of its 1955 line. It was known that in many homes two kinds of concentrate are regularly stocked in the refrigerator. One is orange, the other may be lemon, lime, or some other juice. Two containers for concentrate were therefore required, size one pint each, plus a two-quart water tank, with appropriate connections with the household water system, and a metering mixing valve. Thus it would be possible for the housewife, or her children, to push a button or otherwise operate the valve, and obtain juice properly mixed with the correct amount of chilled water.



As is always the case with any good new idea, reducing it to practicality required a lot of hard work. The mixing valve was readily obtainable from a valve specialist. Unexpectedly, difficulties arose in connection with the water tank. This is made of red brass, 85/15. Two almost identical one-quart cups are drawn from soft strip, the seam brazed, the necessary water connections brazed in, and the outside tinned.

This would seem to be a simple operation, but Revere was told that there was too much breaking and tearing of the brass in drawing. Although at that time we were not supplying the brass, we were glad to work with the firm which had the tank contract. The Revere Research Department reported that the grain size of the unsatisfactory metal varied between .035 and .050 mm., and that holding the size closely to .050 mm. would cure the difficulty. In addition, suggestions were made as to die design, and die lubricants. Revere also was asked the reason for defects in brazing. This became another project for Revere Research, which sent a man to the plant to study the methods used. After some special work in the laboratory at Rome, N. Y., it was found possible to make a successful adjustment of conventional brazing methods to the ones the fabricator wished to use. Still further, Revere's Methods Department recommended changes in the beading operation, ending breaking there. A Call Report written at the end of all this work states that the customer "is very enthusiastic in his praise."

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ALUMNI CONFERENCE

(*Continued from page 30*)

The term automation, said Professor Gould, originated in Detroit with the automobile industry and generally has come to designate a completely automatic factory. The term is not used much at M.I.T., since the term as used by the automobile industry does not include the important element of feedback, which is an essential part of modern industrial control operations. Industrial control problems, however, are now being given careful study at the Institute, especially in the Servomechanisms Laboratory, and the Department of Electrical Engineering.

Established during World War II, the Servomechanisms Laboratory was primarily engaged in research for military control operations, such as the development of fire control and guidance systems. At present, the emphasis in the Servomechanisms Laboratory is on the industrial applications of control and feedback systems.

An important outcome of research conducted at M.I.T., such as that now being done on servomechanism, is that it greatly stimulates the educational program. The research laboratories are the source of many theses of an intensely practical character. The topic of control cuts across all parts of the Department of Electrical Engineering, and even across all of the Institute's engineering departments. Hence, there is no one place where control techniques are concentrated. The tendency, therefore, is to train students to think broadly in terms of the behavior of dynamic systems whether the systems are actuated primarily by hydraulic, mechanical, electrical, or other means.

Professor Gould stated that, in the Department of Electrical Engineering, attention has been directed to dynamic behavior (process dynamics) with emphasis on techniques of control systems. Initially studies were made of industrial heat exchangers, built in the Department of Electrical Engineering, and there was developed a system that could be applied to control heat operations without interrupting plant production. In this interesting technique, the noise of turbulence of flowing liquids was measured and correlated with temperatures of the liquid. From such information the differential equations of plant operations were set up and these in turn could be related to the essential dynamic behavior of control operations.

Studies in the control of distillation operations were next undertaken from which the Department obtained the necessary background to set up servomechanisms for the control of distillation processes. Mixing of materials, and methods of controlling mixing, are other studies which have been, or are being, undertaken. In addition, the dynamics of life processes in connection with the Department of Biology, are also being studied. An artificial lung, which was designed and built at M.I.T. is one example of feedback technique applied to problems of health. An artificial kidney, too, has been made to work with servomechanisms controlling the pH of an essential body fluid. The Department of Electrical Engineering studies a wide range of problems, and the Servomechanisms Laboratory, as well as the Dynamics Analysis and Control Laboratory, offer wide and varied experience in many fields. Students in Electrical Engineering, Mechanical Engineering, Physics, Mathematics, Civil Engineering, and other groups operate to combine their knowledge so that the end product is the best possible type of control system, using whatever operating mechanism is the most suitable. With respect to means of activation, control systems devised at M.I.T. are not limited to electrical, hydraulic, mechanical, or other single means of operation. That combination of method is employed as will yield the best and most economical means of obtaining the desired control of dynamic operations.

At M.I.T. students are taught to regard a dynamic process as a whole, for the function of the system is considered to be more important than the physical means used to achieve the desired control. Students learn to think in terms of nonequilibrium problems, or in terms of system dynamics, which are closely related to problems of information theory. Although developed primarily in the field of electrical engineering, feedback cuts across many sciences and curricula.

Alumni Officers' Panel Meeting

Following the afternoon program on September 9 devoted to "Research Progress at M.I.T.," those attending the conference took part in several panel meetings to discuss problems in connection with Class and Club activities, or in connection with selection activities of the Honorary Secretaries.

Alumni Fund Program

Under the leadership of Theodore T. Miller, '22, chairman of the Alumni Fund Board, Class Agents and Class Officers met in the lounge of Hayden Memorial Library to discuss problems of class activities in fund raising. Mr. Miller complimented the Class Agents on the splendid work of the past year when more than $500,000 was raised for the Compton Laboratories. Almost half of the Class Agents were present in addition to several Regional and Special Gifts Chairmen.

Mr. Miller outlined plans for the year ahead when there are to be two major objectives, in addition to raising funds for general purposes of the Institute. He spoke of the great need for scholarship money. At present some $54 per undergraduate is available for this purpose. By comparison Harvard has more than $200. This is to be one goal. The other goal is to obtain funds for the improvement of facilities for medical investigations — a field in which M.I.T. is doing outstanding work which will increase markedly with the completion of the Compton Laboratories.

In detailing the 1956 plans, Mr. Miller stated that two innovations which had met with great success last year, namely Regional Solicitation and Special Gifts Solicitation by classes would be expanded and intensified. He also told of the increasing importance and effectiveness of reunion giving on the part of all five-year classes through the Alumni Fund.

(*Continued on page 44*)

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ALUMNI CONFERENCE

(*Continued from page 42*)

A lively discussion period brought out many ideas which will be given consideration by the Fund Board. The Class Agents seemed confident that Alumni generally would respond as never before to the very real and urgent needs which are this year's objectives.

Honorary Secretaries Discuss Admissions

Another group, meeting in the lecture hall of the Eastman Laboratories, under the chairmanship of Bruce F. Kingsbury, '44, discussed activities of the Educational Council and Honorary Secretaries.

There was an excellent attendance at the meeting, in spite of a very busy day. About 110 Council members were present at the conference, and the attendance at the work session was perhaps 150, including members of other groups. The whole Admissions Office staff was present, as was Erwin H. Schell, '12, Professor of Industrial Management, Emeritus, who had so much to do with initiation of the Honorary Secretaries in 1931.

In order that maximum use might be made of the hour available for discussion of admissions problems by this group, "homework assignments" had been mailed to all members of the Educational Council. On the basis of this material, dealing with admissions requirements for students planning to enter M.I.T., attention was focused on criteria for admission, all but excluding scholarship and related questions.

Six complete applications were selected and reproduced into a 60-page homework book; all names and indications of action taken were removed to avoid breaches of confidence. The Council members were then asked to act as Admissions Officers on these applications, and return their decisions on a postcard. In addition, they were asked to predict how well the students would do at M.I.T. These results were tabulated and posted at the meeting; 80 per cent of the group had done their homework. A large poster indicating a "Typical Application Chronology" was devised, which served to show the timing of every phase of an application, from the Council member's first contact at a high school through registration in September.

It was a very lively and interesting meeting which commenced with a discussion of the Admissions process, criteria for evaluating personality characteristics, and criteria for weighing and understanding the several measures of academic ability. Attention was focused on "homework applications" by having various Council members present a case to the group and support his decision to admit or to reject. There was a nice amount of disagreement among Council members and between Council members and Admissions Officers, so that discussion was spirited. Many valuable points were brought out in this manner – the most important being that everyone was convinced that there is no one type of candidate for M.I.T They run a full and normal range of human personalities and a rather wide range of intellectual abilities. Admissions – it was obvious – could be based on many combinations of these factors; a careful weighing of the characteristics of each individual applicant by experienced Admissions Officers, utilizing the judgment which comes only from experience.

This work session served to orient the Council members; to give them a gauge of their own interviews and activities and to give them a far better picture of how their own activities fit into the Admissions selection process.

Alumni Clubs

The third group, under the chairmanship of H. E. Lobdell, '17, Executive Vice-president of the Alumni Association, met in the Moore Room of the Eastman Laboratories and discussed problems of concern to club officers. Mr. Lobdell opened the meeting by introducing Dwight C. Arnold, '27, President of the Alumni Association for the year 1955–1956, and Miss Madeline R. McCormick, Assistant Treasurer of the Association.

From considerable experience with the 92 alumni clubs during the past six years, during which time he has traveled some 325,000 miles, Mr. Lobdell outlined the activities of alumni clubs, pointing out that local conditions usually do and should determine the number and character of meetings held by the clubs. Although many clubs have similar problems and often meet them in similar manner, this is by no means universally true. Whereas some clubs find it advantageous to meet once a month, some, on the other hand, meet only once a year or at infrequent and irregular intervals.

Mr. Lobdell also briefly reviewed the growth of Regional Conferences, the first one of which was held in Chicago in 1951. During the past year, particularly successful conferences were held in Dallas and Cleveland; for the coming year conferences are scheduled to be held at Los Angeles and in St. Louis.

Mr. Lobdell then called on various persons to comment on activities of the clubs they represented. Those taking part in this discussion included Joseph E. Conrad, Executive Secretary of the M.I.T. Club of New York; Horace E. Weihmiller, '25, M.I.T. Club of Long Island;* Dale D. Spoor, '22, M.I.T. Club of Westchester;* Russell P. Westerhoff, '27, M.I.T. Club of Northern New Jersey; Arthur W. Davenport, '23, M.I.T. Club of Virginia; F. David Mathias, '36, M.I.T. Club of Quebec; George J. Fertig, '24, M.I.T. Club of Alabama; Antonio H. Rodriguez, '21, M.I.T. Club of Cuba; and Bernardo Elosua, '23, M.I.T. Club of Monterrey, Mexico.

Reception at the President's House

Between 6:00 and 7:00 P.M. on Friday evening, those attending the Alumni Officers' Conference were guests of Dr. and Mrs. Killian at the President's House where refreshments were served in the garden. This pleasant occasion provided opportunity for Alumni to relax from their "refresher courses" and to make new friends.

(*Continued on page 46*)

*Affiliate M.I.T. local club.

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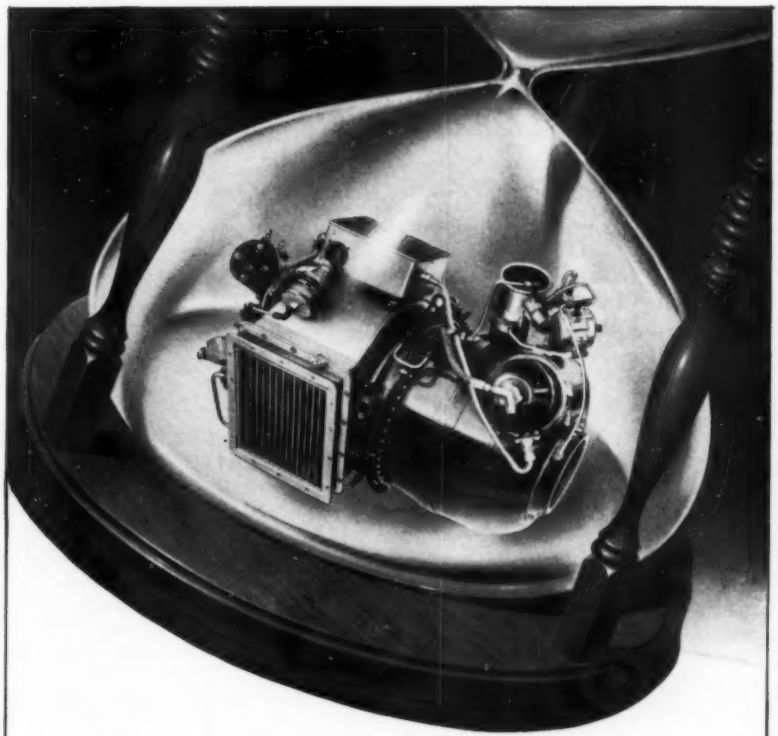

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ALUMNI CONFERENCE

(*Continued from page 44*)

Dinner at Walker

At 7:00 P.M. a buffet dinner was held at Walker Memorial, which had recently been renovated, repaired, and repainted, and supplied with new furniture. The tables and chairs were so new, in fact, that an adequate supply to accommodate all those in attendance arrived only on the day of the conference.

Upon conclusion of a delicious meal, made doubly attractive by the artistry of Walker chefs, Mr. Arnold opened the business portion of the dinner meeting by paying tribute to the chefs. He then reported on the origin of the conference, as follows:

At this time it is probably appropriate that I mention briefly the origin of this Alumni Officers' Conference. Over a year ago – in May, 1954, to be exact – the Executive Committee of the Alumni Association invited Jim Killian to spend an evening with them discussing ways in which the Association might be of greater help to him and to M.I.T. To us of the Association that was a particularly successful evening. We greatly appreciated the chance to learn firsthand of some of the Institute's problems and challenges as seen from the President's Office. But there were very tangible results of that evening. As some of you know, at President Killian's request the Association has since been nominating three alumni members to each of the Corporation's Departmental Visiting Committees – instead of two which had been the previous practice. We were encouraged to conduct two regional conferences instead of one each year. Last year they were in Dallas and Cleveland. This year there will be a regional conference in St. Louis, and Los Angeles will have its second regional conference. The chairman of the Alumni Fund Board, Theodore T. Miller, '22, was made a member of the Institute's Development Council, and I might add that since then he has been attending all Executive Committee meetings and conducting bi-weekly meetings on Alumni Fund matters with Henry B. Kane, '24, Director of the Alumni Fund, H. E. Lobdell, '17, and Donald P. Severance, '38, Executive Vice-president and Secretary, respectively, of the Alumni Association. These are some of the results of that one meeting. This conference is another result of that meeting. Let us hope that this conference in turn, leads to further ways of our being of help to M.I.T. and to further refinements in our current methods.

One other point about this week end's conference. We have packed a lot of material into one and one-half days. But no matter how much we packed into this program, we obviously could not bring into this conference representatives of all five of M.I.T.'s schools. We wished we could. But, would the two Deans who escaped participation in this year's program please keep their calendars free for an invitation from the committee responsible for our next Alumni Officers' Conference.

Bronze Beaver Awards

President Arnold then turned the meeting over to Hugh S. Ferguson, '23, Past President of the Alumni Association. Mr. Ferguson then made the first Bronze Beaver Awards for distinguished service to the Alumni Association. Said Mr. Ferguson:

It was very thoughtful to give me this opportunity to present the first Bronze Beaver Awards for distinguished

(*Continued on page 48*)

Launching view of the Seawolf, America's second nuclear-powered submarine, for which Combustion built the reactor vessel and other components of the nuclear power system.

Combustion Engineering, *Builder of Nuclear Components for Seawolf,* becomes Third Major AEC Contractor to enter Naval Reactor Development Program

On August 11, the Atomic Energy Commission announced the award of a contract to Combustion Engineering for the design, manufacture, assembly and test of a submarine nuclear power reactor and its related equipment. Only two companies had previously been awarded such contracts—the Westinghouse Electric Corporation and General Electric Company.

Combustion brings to this important assignment the experience already gained in building the reactor vessel and other related components for both the Seawolf and its prototype in the sphere at West Milton, N. Y., which recently became the first nuclear source of commercially distributed electricity for public use. This experience is further augmented by design, research and development work in the field of atomic power over the past eight years, including the manufacture of the reactor vessel, presently in process, for the AEC-Duquesne Light plant —the country's first commercial-size nuclear power station.

In executing its AEC submarine contract, Combustion will utilize new manufacturing facilities now being erected at its Chattanooga plant, plus additional facilities to be established in a new Nuclear Engineering and Development Center scheduled for completion in 1956. *Thus Combustion Engineering will become the first company in the country to provide its own facilities for the construction of a naval nuclear reactor.*

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ALUMNI CONFERENCE

(Continued from page 46)

service to the M.I.T. Alumni Association. Tonight, there are three recipients: one to a Class Secretary, one to a Class Agent of the Alumni Fund, and the third, a Club Award.

A Class Secretary's job is a thankless one. Extracting factual news from a few hundred elusive classmates scattered all over the world, and then writing it so that it would be interesting to the class and yet concise enough for the editor of The Technology Review, is a monumental task.

Our Association is fortunate in having many Class Secretaries whose effectiveness is evident not only in the columns of The Review, but also in the effectiveness of the class as a whole. It was difficult for the committee to select, from so many, one to honor tonight. To the one Class Secretary chosen in 1955, unfortunately, Cac [Carole A.] Clarke, who is usually present at our annual Alumni Day and Educational Council and Club Officers' Dinners, could not be with us tonight, for I would have liked giving him this Bronze Beaver in the presence of so many of his friends from the Class of 1921 and the M.I.T. Club of Northern New Jersey. In his absence, would the President of the Class of 1921 — Raymond St. Laurent — accept this award in his behalf?

Mr. Ferguson then turned over to Mr. St. Laurent the Bronze Beaver Award first to be awarded to a Class Secretary. The inscription accompanying this Alumni Award stated:

"For more than 30 years you have served M.I.T. and your fellow Alumni with enthusiasm and a high degree of effectiveness as Club Officer, Class Agent and Honorary Secretary. Since graduation your class notes have been characterized by a consistency, accuracy, newsworthiness, and completeness. Your close contacts with your classmates have made your monthly columns a true reporting of the activities of your class and a model for other Class Secretaries. Therefore, in grateful recognition, the 1955 Bronze Beaver for distinguished service to the M.I.T. Alumni Association is awarded to Carole A. Clarke of the Class of 1921."

After reading this citation, Mr. Ferguson resumed presentation of awards, saying:

Many of the men in the room tonight have been closely associated with the Alumni Fund since its beginning 15 years ago. Many of you have had a part in personal solicitation within the classes, and still others in the regional solicitation that was successfully tried this year for the first time. We all were anxious that this past year's Fund — devoted as it was to the Karl Taylor Compton Memorial — be an outstanding success and a real tribute. I know we all were truly gratified when Mr. Miller was able to report on Alumni Day that the Alumni Fund had beaten all previous records for numbers of contributors and had been able to turn over to the Institute more than a half million dollars. Before presenting this next award to a Class Agent of the Alumni Fund, I want to add my personal appreciation and that of the Alumni Fund Board to all who helped us make the largest single stride since the founding of the Fund, with particular thanks to the Class Agents, the backbone of the Alumni Fund. And now — to the Class Agent chosen in 1955, will Alf K. Berle, '27, please step forward?

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In presenting the Bronze Beaver Award in recognition of Mr. Berle's outstanding services as Class Agent, Mr. Ferguson read the citation that went with it, as follows:

"Since the inception of the Alumni Fund, you have served your class, the Alumni Association, and M.I.T. as Class Agent for the Alumni Fund. You have used imagination and initiative far beyond the usual requirements of this office in the performance of your duties. Your complete co-operation has resulted in the establishment of the very effective special gifts program. Under your leadership, your class has been a consistent leader in the financial support of M.I.T. Therefore, in grateful recognition, the 1955 Bronze Beaver for Distinguished Service to the M.I.T. Alumni Association is awarded to Alf K. Berle of the Class of 1927."

Mr. Berle received the award with grateful appreciation and Mr. Ferguson continued:

Making the two previous awards was easy, because they were to men I know personally. However, a Club award is like a regimental citation – one given in recognition of the joint efforts of many hands and minds applied to a common cause. Some of you here today attended the Regional Conference in Dallas on January 29 of this year – a conference which I wish all of you could have witnessed. It is in recognition of this fine meeting that we make next a Club award.

Would J. Russell Clark, '29, and Jonathan A. Noyes, '12, of the M.I.T. Club of Northern Texas, step forward to receive this award for the clubs of the Southwest and for the Dallas Club in particular – and please take back congratulations to the other members of your committee, especially Edward O. Vetter, '42, who was chairman and Cecil H. Green, '23, then President of your club.

As these two Alumni from the Southwest came forward, Mr. Ferguson read the text of the citation:

"To the M.I.T. Clubs of Dallas, Fort Worth, Houston, Mexico City, Monterrey, New Orleans, and Tulsa, who sponsored the fifth regional conference of the Alumni Association, greetings. The thoroughness of your planning, the smoothness of your operation, and the news coverage you gave this conference all set a new standard for future meetings. Your concerted energy in gathering some 400 Alumni and industrial and civic leaders to this meeting made it an event outstanding in the Association's history; therefore in grateful recognition, the 1955 Bronze Beaver for Distinguished Service to the M.I.T. Alumni Association is awarded to the M.I.T. Clubs of the Southwest and placed in the custody of the M.I.T. Club of Dallas."

Mr. Ferguson then turned over to Mr. Noyes, the award, as shown at the bottom of page 28, and Mr. Clark made brief response of appreciation on behalf of those honored by this presentation.

Upon presentation of the Bronze Beaver Awards, the meeting was once again turned over to Mr. Arnold who paid tribute to Mr. Ferguson for his leadership last year as President of the Alumni Association. Despite heavy obligations to the firm of Dewey and Almy, of which he is the head, Mr. Ferguson found it possible to attend every meeting

(Continued on page 50)

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ALUMNI CONFERENCE

(Continued from page 49)

of the Alumni Council. In addition, he was present at both Regional Conferences. Mr. Arnold then presented a gavel to Mr. Ferguson in recognition of his year of leadership of the Alumni Association.

In response, Mr. Ferguson stated that the past year had been one of the most satisfying years of his life. He mentioned especially the fine spirit of cooperation that he had enjoyed at every turn, and said that, despite a busy year, the post as President of the Alumni Association has been full of satisfaction.

Alumni Role in M.I.T. Progress

Mr. Arnold then introduced James R. Killian, Jr., '26, M.I.T.'s President, who was obviously touched by the welcome he received and the spirit of the occasion. He had no idea so many loyal Alumni would attend the First Alumni Officers' Conference. President Killian then commented on the recent redecoration of Walker Memorial and interpreted the murals for the benefit of those who had not previously heard their meaning. He then paid tribute to Lester D. Gardner, '98, who, almost singlehanded, had raised $350,000 for the Jerome C. Hunsaker Professorship in Aeronautical Engineering. Tribute was also paid to the Alumni Association whose 1955 Fund, of more than one-half million dollars, served as a fitting tribute to Karl T. Compton, in whose honor the Fund was raised for new laboratory buildings in the physical sciences, which building is now under construction. Dr. Killian then delivered his major address, which, in part, is as follows:

We here at M.I.T. deeply value this opportunity to meet with you. We welcome too the opportunity of expressing to you in person our deep sense of appreciation for what you individually and collectively are doing for M.I.T. As honorary secretaries, members of the Educational Council, class officers or class agents, your contribution of time and interest is important to the welfare of technology. I know of no institution which commands more constructive loyalty on the part of its Alumni and in which alumni attitudes and relationships so effectively avoid the trivial and stress the basic aims and functions of the institution.

This meeting also affords me an opportunity to note with gratitude a variety of specific accomplishments of the Alumni Association and its constituent bodies. First, I would speak of the Alumni Fund which I had an opportunity to observe being established some 15 years ago. Since its foundation it has grown to be one of the most successful living endowment activities in the country with alumni contributions to the Institute ranking in the upper 10 among all the institutional groups in the country.

Since the Alumni Fund was started, Alumni have contributed to it a total of $2,539,125.25 to the Institute. The Alumni Fund made possible among other things the building of additional tennis courts at the Institute, the completion of the Hayden Memorial Library and climactically during this last year, it raised over half a million dollars for the Karl Taylor Compton Memorial Laboratories, this bringing an equivalent amount into the total sum of $7,000,000 which we are trying to raise for this project. In fact, it is fair to say that the success of the Alumni Fund has insured the success of this project and

(Continued on page 52)

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ALUMNI CONFERENCE

(Continued from page 50)

the large amount it raised encouraged the Executive Committee to go ahead with the authorization to start the building.

The success of this Alumni Fund activity echoes the magnificent aid of M.I.T. Alumni in our $20,000,000 Development Program of six years ago which owed much of its success to alumni contributions. Alumni workers and an alumni body have for years promoted the welfare of M.I.T.

It is also worthy of note that your Alumni Fund Board was awarded first prize by the American Alumni Council for significant achievement in the use of direct mail to promote capital gifts fund-raising, this award having been won in competition with 83 colleges and university alumni associations. Another matter of great significance in the life of this institution has been the alumni participation in its policy-making and in its governing bodies. Of the 35 life members of the Corporation, 27 are Alumni. In addition, there are 15 term members nominated by the Alumni Association for five-year terms.

Alumni also share actively in the work of the Corporation Visiting Committees which are appointed by the Corporation for each department and several divisions of the Institute. The Alumni Association nominates three members for each of these Visiting Committees in addition to the members of the Corporation and the presidential appointments which make up each committee.

Both our honorary secretaries and the Educational Council have contributed importantly to the spotting, encouragement, and selection of students at the Institute, a work that will most certainly increase in importance.

I would also call attention to the new 1955 *Alumni Register* which has been prepared wholly under the direction of your Alumni Officers. Seventy-five per cent of all of our former students returned questionnaires providing information for this *Register*, and its sales among Alumni have been sufficiently large to cover the major portion of its cost. It is interesting to note further that the sales of our *Alumni Register* exceed those of our sister institution, Harvard, which has three times the number of Alumni.

As important as these special activities and accomplishments of the Alumni Association and its members is the ever-present helpfulness of our Alumni for those of us here in Cambridge. I repeatedly find it wise and always helpful to go to many of you for help and advice on a variety of policy questions that come up about the administration of the Institute, and I never fail to receive a cordial response. Perhaps this kind of relationship is the most important of all the many aspects of our alumni relations, the imponderable effects of interest and loyalty which are hard to record in specific ways but are nevertheless powerful factors in the corporate strength of the institution. The real test of this corporate vigor and strength is to be found in the achievements of our graduates, and from where I sit, this seems to be increasingly impressive. The Alumni of this institution collectively represent one of the major forces for strength, for progress, and stability in this country, and their influences are enormous both in professional and national life. One has to occupy a vantage point such as mine in order to appreciate fully such an impressive record. Let me cite just one statistical fact: in a recent year, M.I.T. Alumni

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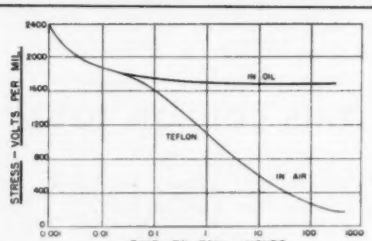
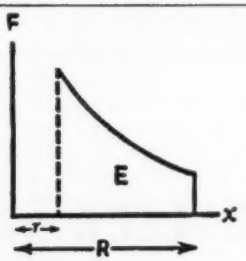


THIS GRAPH shows voltage-life tests of Teflon film 0.005" in thickness. Note the comparative long life of Teflon protected with oil. BIW process for manufacturing Teflon insulated cables protects with dielectric oil.



BIW TYPE PFGV consists of flexible copper conductor insulated with a laminated layer of Dupont Teflon sealed with oil to form a moisture-proof insulation which remains flexible after exposure to high temperatures and may be operated continuously at 150° C or for limited periods at 200 or 250° C.

THIS GRAPH shows the relative potential gradient in cables where: Area E represents the impressed voltage, r is the radius of the conductor, R is the radius of insulation, F is the volts per unit stress at any point x distance from the center of the cable.

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held the presidencies of 12 national professional organizations.

Mr. Arnold concluded the evening meeting by calling the names of those who had traveled the greatest distance in attending the conference. Those singled out for special mention in this connection were: Antonio C. M. Nunes, 2–46, of Rio de Janeiro; Antonio H. Rodriguez, '21, of Havana; Bernardo Elosua, '23, of Monterrey; Gaynor H. Langsdorf, '32, from San Francisco; William H. MacCallum, '24, from San Marino; Barrett B. Russell, 3d, '43, Tulsa; Messrs John R. Clark, '29, and Jonathan A. Noyes, '12, Dallas; Kenneth H. Klopp, '32, Spokane; John Ayer, Jr., '36, Denver; and Earl L. Bimson, '43, Phoenix.

Student Government

After breakfast at Baker House the Alumni Officers' Conference continued at 10:00 A.M. on Saturday morning, September 10, with a session on "Undergraduate Student Government at M.I.T.," held at the Kresge Auditorium. Norman C. Dahl, '52, Associate Professor of Mechanical Engineering, and chairman of the Freshman Advisory Council, presided.

Professor Dahl opened the session by reviewing the origin and current operations of the Freshman Advisory Council, which is a group of 70 Faculty members each of whom is particularly interested in student problems and has taken responsibility for assisting about 15 freshmen in their adjustment to college life at the Institute. The aim of this group is to: (1) facilitate a better transition to life at the Institute and to aid students in developing a closer contact between professors and students; (2) continue study of the needs of counseling and of student adjustment to life at the Institute; (3) develop a program of guidance on professional course selection.

"You will note," said Professor Dahl, "that there is no reference in these objectives to what might be called 'The Law of the Squeaking Wheel'; that is, the Faculty is not preoccupied with the failing student, nor did it want the Freshman Advisory Council to be so preoccupied. We are, of course, distressed when a student fails at the Institute, but I think it is equally true that we were more distressed when a boy of outstanding promise has only a mediocre performance. The aim, then, of the Faculty Advisory Council was to aid each freshman in realizing his own potential, at whatever level this might be."

In contrast to the views held at some colleges, said Professor Dahl, M.I.T. believes that wise counseling is a problem to be solved by the Faculty and Administration acting together, and that except in unusual circumstances, student committees should not be relegated to "professional" counselors, such as physicians, psychiatrists, or psychologists. "We realize that there are instances when professional or psychiatric or guidance work is necessary" said Pro-

(Continued on page 54)

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ALUMNI CONFERENCE

(Continued from page 53)

fessor Dahl, "but we also believe that the most desirable educational situation is that where the rapport between the student and Faculty is such that the student is willing to trust the Faculty member with some of his personal problems. This leads to better mutual understanding, and if we believe in the tenet that knowledge brings understanding, the effect on the educational process must be beneficial."

Professor Dahl then explained the operation of the Freshman Advisory Council; how freshmen meet their Faculty advisers who get to know a small group of students well; how the students have opportunity to visit their Faculty adviser in his home; how they may come to him for advice on problems – academic or otherwise – throughout the year, and how the Faculty adviser attempts to aid the student by discussing and analyzing the student's problems so that the student can make his own decisions regarding questions that have bothered him. Faculty members do not attempt to function as "a parent away from home" but rather as an older, sympathetic friend who will help the student in the problem of adjusting to college life and mature living.

In recent years an important activity in enabling freshmen to adjust to their new life at the Institute has been the comments the Institute receives from parents and headmasters after the student is admitted to M.I.T. These are available to the freshman advisers and frequently enable him to aid the new student in overcoming difficulties that might otherwise not be discerned.

Dormitory Living

Professor Dahl then introduced Herbert S. Amster, '56, chairman of the Dormitory Council, who spoke on dormitory life at the Institute. Mr. Amster stated that the newness and strangeness of coming from a small high school (where the student is well known) to a large college (where he is virtually unknown) is a major hurdle for most freshmen to make. The orientation program which is given to freshmen as they come to M.I.T. is an important matter in overcoming this strangeness. The closeness of student living in dormitory units also is an effective method of overcoming this hurdle. The freshman lives next door to, and eats with, other students who have the

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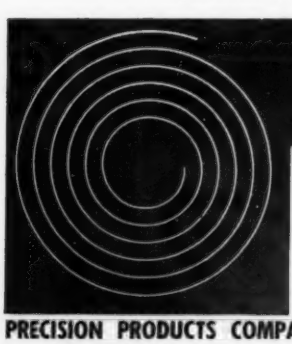

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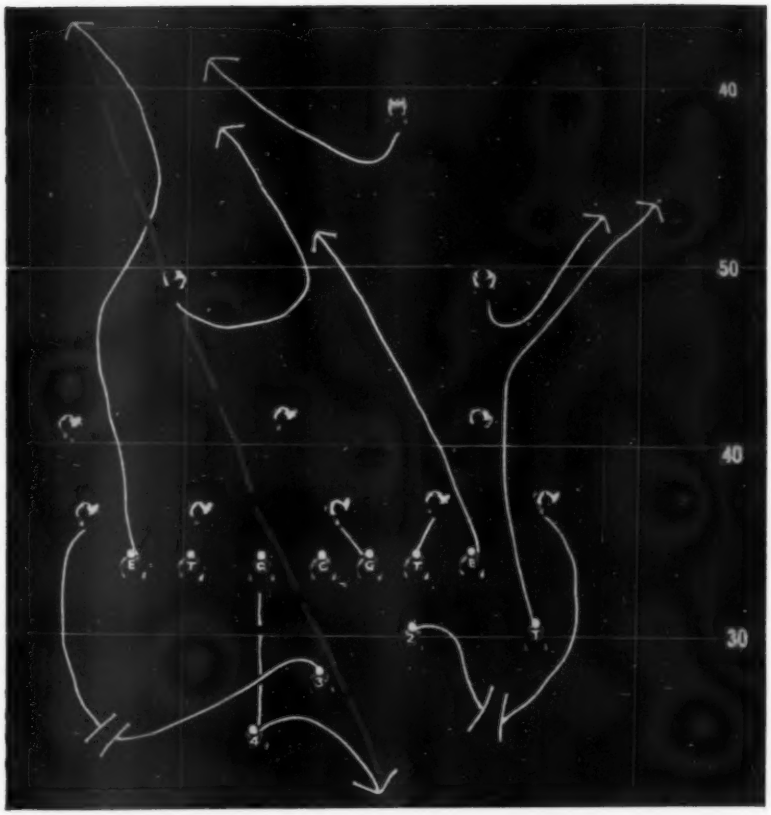

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ALUMNI CONFERENCE

(Continued from page 54)

same aims, aspirations, and ambitions as he does; he gets to know most of his dormitory associates quite well. He can close himself up and lead a life of seclusion if he insists on so doing, but he can also make friends, and develop his individuality and maturity through dormitory living.

The student living in the dormitory has a good social life. He is encouraged to participate in intramural sports and he can participate in dormitory government, for the dormitories are operated by rules which the students themselves establish and administer. Thus the students learn the meaning of accepting responsibility for their own actions, early in their life at the Institute, said Mr. Amster.

Each dormitory has a Faculty resident adviser to whom the students may go for advice and the development of friendship, but this adviser takes no part in student government; he does not serve as a policeman or an overseer.

Each of the three major dormitory units – East Campus, Baker House, and Burton House – has a Dormitory Committee with a student as chairman. There is also a co-ordinating committee which co-ordinates activities of the three dormitories. These groups of students are concerned with such problems as living conditions in the dormitories, study conditions, eating facilities, recreational and athletic activities and so on. The student government establishes rules of conduct for its own dormitory residents, solves problems which may arise as the result of damage to property, and thus develops awareness of other people's property. It is concerned with social life in the dormitories, and the orientations that are necessary to bring together groups from different parts of the country or even from different parts of the world.

Fraternity Problems

As chairman of the Interfraternity Conference, George W. Luhrmann, Jr., '56, spoke on the educational and social opportunities which were provided for those living in the fraternities at M.I.T. So far as the Institute is concerned, its policy with respect to students living in the fraternities is the same as that for students living in the dormitories – each student shall be responsible for his individual action, and the Administration sets few, if any, restrictions beyond the expectation of gentlemanly behavior on the part of its students.

Mr. Luhrmann reviewed, briefly, a conference held last year at the Institute at which M.I.T. students discussed the problems of discrimination. Mr. Luhrmann reported that the desirability of judging a person on his individual characteristics and merits was clearly recognized, but pointed out that the charters of fraternities sometimes had membership restrictions incorporated in them, and that a revolutionary, rather than evolutionary approach to this problem might easily jeopardize the fraternity system in the country as now set up. It was recognized that this –

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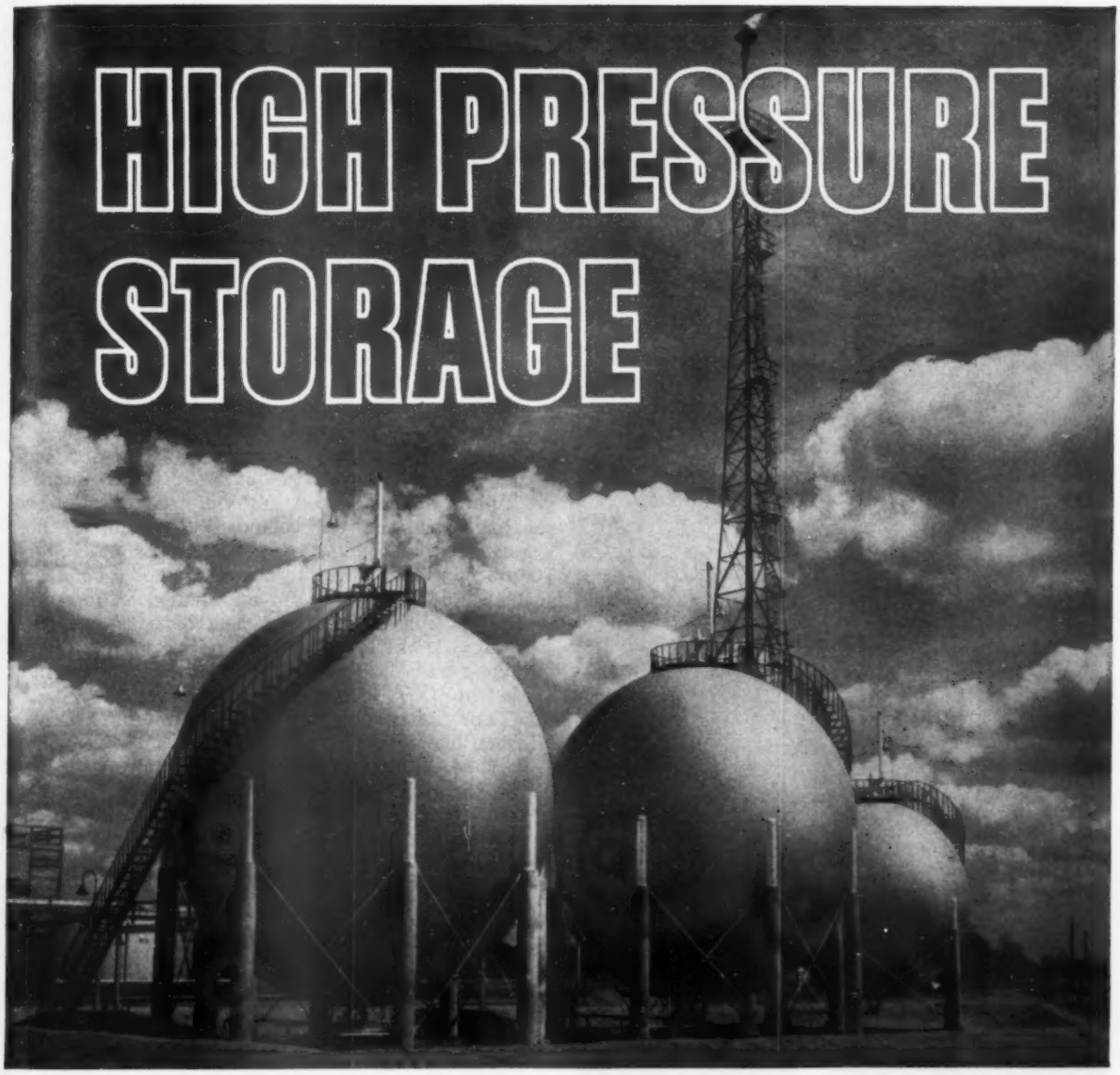

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ALUMNI CONFERENCE

(Continued from page 56)

and many other problems of student living — are solved from within, by the students themselves, rather than by attempting to impose co-operation.

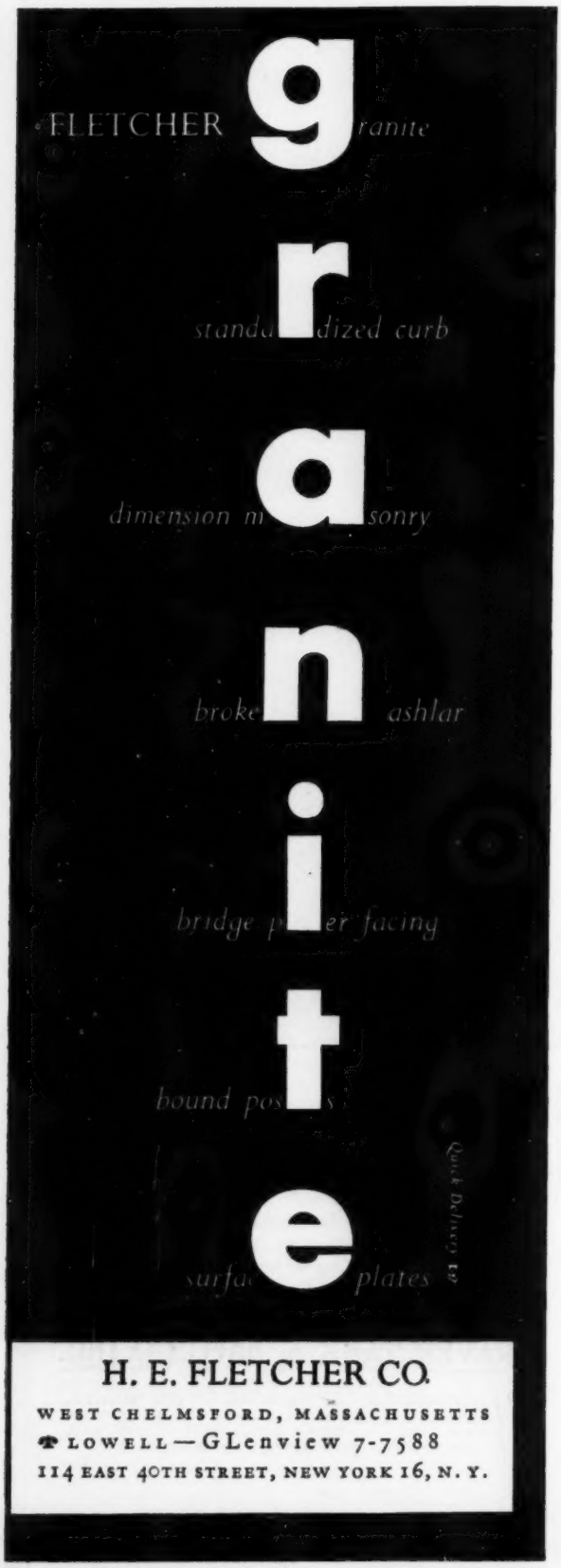
The aim of those living in fraternities is to stimulate such modes of living and conduct as will maximize development and maturity of the students. Toward this end the fraternities are concerned with the scholarship records made by their members. At the present time the scholastic record of those living in the fraternities is the same as that for the student body as a whole. The fraternities have set up awards for the highest ratings in the 27 fraternities, as well as awards recognizing greatest improvement. Another award is set up for that fraternity house whose pledges make the best scholarship record.

The Interfraternity Conference assumes responsibility for rushing activities at the Institute; publishes a news bulletin called *Fraternity Times,* stipulates that houses on the campus must maintain high standards of conduct as well as proper and suitable procedures in their business transactions; and provides for an exchange of information on marketing and purchasing for the benefit of house stewards. Last year M.I.T. fraternities won second place in national fraternity competition, and this year the hope is that M.I.T. will do even better.

For the coming year the Interfraternity Conference has among its objectives the improvement of scholarships among fraternity men and further work on the problem of discrimination. Work has been done toward having WMIT, the local radio broadcasting system, feed programs to the fraternities as well as to the dormitories. The Interfraternity Conference is also giving consideration to hastening the recent change from "hell week" to "help week," as well as to problems that require solution with regard to the possibility of gradually moving fraternity houses from Boston to the Cambridge side of the Charles River, said Mr. Luhrmann.

Final speaker on the morning program of undergraduate student government was John S. Saloma, '56, chairman of the Institute Committee, who presented "An Evaluation of Student Government." Readers of The Review will find Mr. Saloma's remarks presented as a feature article on page 31 of this issue.

Upon conclusion of the morning discussion on "Undergraduate Student Government at M.I.T.," laboratories, as well as the library, were open for in-



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spection of those attending the Alumni Officers' Conference. It was not expected that each conference attendant would visit all of the laboratories open for the occasion but rather that he would elect to visit one or two which were of greatest interest.

Luncheon at the Faculty Club

The conference ended with a luncheon at the Faculty Club at 12:30 P.M. on Saturday, September 10. John J. Wilson, '29, was master of ceremonies for this event, and Edward L. Cochrane, '20, Vice-president for Industrial and Governmental Relations, was the luncheon speaker.

Admiral Cochrane's address, which served as epilogue and summary of two-days' events, commented on the growth and changes which were certainly clearly evident to those who attended the conference, and pointed out that change does not necessarily mean improvement. Nevertheless, there has been, and continues to be, a steady trend of real progress in the Institute's forthright program under President Killian who has won the enthusiastic support of members of the Administration, the Corporation, the Faculty, and Alumni.

Brief outlines of some of the work going on at the Institute have been given by Deans Harrison, Burchard, and Soderberg, commented Admiral Cochrane. But there is growing complexity in our technological way of life, and only a brief picture of the manifold activities of M.I.T. could be unfolded in the day and one-half conference. The human species is growing mentally as well as physically, and the demands now being placed on students are proceeding at an alarming speed. The need for technically trained personnel is hardly now met by the supply, and the outlook for the future is not too bright, unless much greater attention is given to this problem, said Admiral Cochrane. The Institute's greatest problem is to maintain the quality of its education, while simultaneously doing what it can to help meet the need for increasing numbers of competent and technically trained personnel.

For a number of years one of the things the Institute has been doing to meet the growing need for science teachers is to hold summer sessions at which a selected group of secondary school teachers receive a refresher course in the physical and biological sciences. This program, it is expected, will ultimately enable the Institute to turn out better

(Continued on page 60)

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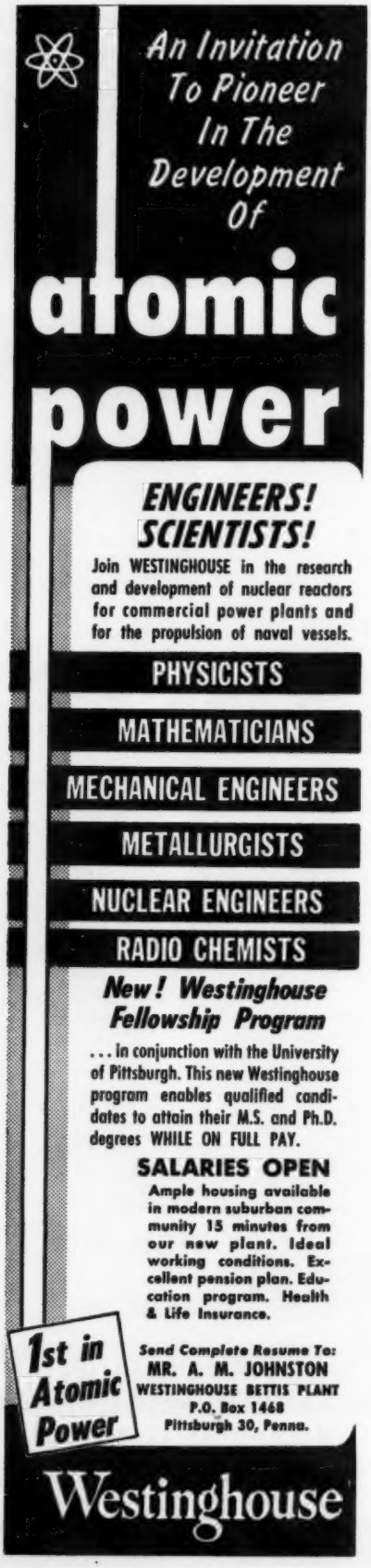
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(Continued from page 59)

trained graduates, for, in a very real manner, science teaching in the secondary schools affects the Institute's admissions program. More important, the properly qualified teacher can often stimulate a student to enter science or engineering, who might otherwise elect to pursue other fields. Admiral Cochrane pointed out that, ultimately, it might be possible to make up for a lack of adequate teaching at the high school level, but it is not possible to make up for neglected opportunities to inspire and encourage properly qualified students to enter technological fields of activity if the opportunity is missed.

Another program of training secondary school science teachers, originally related by Joseph W. Barker, '16, was reported by Admiral Cochrane. Secondary schools in Niagara Falls arranged to provide a training program for their science teachers, in order that their grasp of science and engineering might be improved and better instruction passed on to their students. Business firms and industries in the area gave wholehearted support to the program. Better training of students is an immediate result of such a program, but even more important, in the long run, is the improved standing and status which the teaching profession achieves by such programs.

The growing complexity of technology is rapidly increasing the problems confronting science teachers, and changes in the curriculum are rapidly being made to meet new conditions. The core of early engineering training survives in some of our engineering societies, but engineering education has left the apprentice stage, only a vestige of "handbook engineering" remains, and much greater emphasis than in

(Continued on page 62)

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ALUMNI CONFERENCE

(Continued from page 60)

the past is now being placed on the scientific fundamentals of engineering rather than on techniques of practice. At the Institute the boundaries between departments are disappearing – except for administrative purposes – and students and Faculty alike find a healthy interplay of interests and activities in their work in many departments. Most of the laboratories, such as the Acoustics Laboratory, the Servomechanisms Laboratory, or the Dynamic Analysis and Control Laboratory, to cite three examples, are staffed by specialists of many different types of training and disciplines. This makes it almost certain that students and Faculty alike will obtain an overall picture of current technical progress free from the narrow limitations of instruction in a single course.

Commenting on the tragic loss of Karl T. Compton, on June 22, 1954, Admiral Cochrane recalled that it was during the Compton administration that the hard core of science subjects was so greatly strengthened at the Institute. His work at the Institute made Dr. Compton a leader of international renown, and for this reason he was often called away from the Institute a good part of the time between 1942 and 1954. The undergraduate school is the basis for training and supplying recruits for the graduate school which also increased in size considerably under Dr. Compton's administration. Educational work in the sciences must be based on research, and Dr. Compton knew from first hand experience the meaning and value of research; he also knew that research had to be conducted by a vigorous Faculty in touch with the realities of technological progress.

At the present time, the volume of research being done on the M.I.T. campus reaches about $12,000,000 annually. Much of this is sponsored by the government. The Institute would prefer not to do classified research, for restriction of knowledge required in classified work is inconsistent with the educational process. Moreover, research contracts are not accepted unless they receive the enthusiastic support of at least one Faculty member who can oversee its progress. The Institute has serious obligations to the national welfare which must also be considered in accepting research tasks for which its personnel and facilities may be uniquely qualified.

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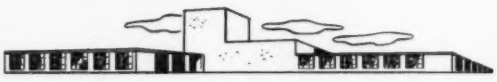

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(Concluded from page 62)

for the most part, at the Lincoln Laboratories, administered by, but separate from, M.I.T.

The Institute has recently made a significant contribution to one phase of national welfare in making President Killian available to conduct a project on classified research in Washington, at the request of President Eisenhower. In this assignment, which is now concluded, President Killian served as chairman of a panel having the high level responsibility of advising President Eisenhower. Dr. Killian led a group of first-class scientists, and his personal contribution to this work is regarded as of the greatest importance. This work has again established the fact that the Institute is without peer in technical leadership, stated Admiral Cochrane.

In conclusion, Admiral Cochrane said he hoped that the conference might be instrumental in rekindling enthusiasm for M.I.T., and that those who attended might return to their communities with a better understanding and appreciation of what the Institute is doing, what its problems are, and how it is meeting its current demands. He expressed the hope that the conference would also be useful in making recommendations regarding students who would benefit most from being admitted to the Institute as freshmen. Finally, Admiral Cochrane thanked those present for attending the conference, and adjourned the meeting at 2:00 P.M.

Epilogue

Of course it is too early to evaluate the true effectiveness of the conference; only time will demonstrate its full value. But there was universal feeling among those who attended, or had had a part in arranging for it, that the conference had been immensely instructive, that it had provided opportunity for many Alumni to recognize that the "Tech is hell" motto of their student days needs considerable modification to apply to the present M.I.T. Those who came had opportunity to witness the vast expansion and growth of the Institute, in physical plant, in student body, in emphasis on research and graduate work, and in general living conditions of the students. They could not help but be impressed by the fact that the Institute of 1955 is quite a different – and far better – place than it was when they were students.

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LISTING alphabetically within its 642 text-pages: 47,210 living alumni (from Aall, Jacob '50 of Tvedestrand, Norway, to Zych, Edward A. '45 of Chicopee, Mass.); 11,968 deceased alumni (Abare, Lawrence P. '30 to Zitz, Frederick C. '95); 388 members of the Corporation since 1862; 9,119 members of the Faculty and Staff since 1865; and 196 officers and Executive Committee members of the Alumni Association since 1875.

All alumni, living and deceased, are cross-indexed according to Class affiliation; and 44,274 alumni (94 per cent of those living) are cross-indexed geographically according to their addresses as corrected to February 15, 1955.

Over 6,300 copies, ordered by "advance subscribers," have been delivered. . . . Additional copies *paperbound* for post-publication sales are now available and orders at $6.00 per copy postpaid will be filled in the order of their receipt by the

Alumni Association
Room 1-280, M.I.T.
Cambridge 39, Mass.

PRESIDENT'S REPORT

(Continued from page 34)

unremitting effort to open up new educational areas within our jurisdiction and thus to educate men and women competent to meet industry's rapidly changing technological needs.

. . . We have sought to provide new competence and to increase knowledge of advancing science and technology through our extensive program of adult education. Last year we held 12 conferences for representatives of the industrial companies in our Industrial Liaison Program, and this past summer our Summer Session, with 32 special conferences, advanced courses, and seminars, drew 1,800 from industry, government, and educational institutions. This kind of special adult education is becoming a major part of the Institute's educational mission.

. . . M.I.T. has sought to help in meeting our national manpower needs by its attempt to strengthen and invigorate science teaching in the secondary schools. Jointly with the Harvard Graduate School of Education we have established a five-year program designed to prepare students of science and engineering for teaching in secondary schools. So far the enrollment in this course is very small, but it shows signs of growing. Last month the Executive Committee authorized special scholarships to encourage students to enter this course. . . .

The serious problem of providing ample financial support for privately endowed educational institutions, so that they may pursue their programs of free inquiry unhampered by governmental directive, are discussed by President Killian. So, too, is the in-

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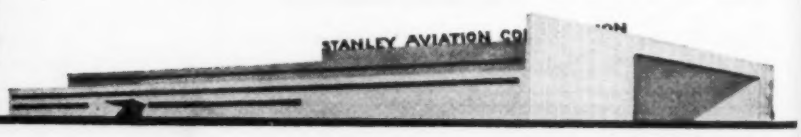

creasingly disturbing problem of providing the highest possible level of educational opportunity for intellectually able students of restricted financial means. This problem has already been presented to Review readers in its report of President Killian's Alumni Day luncheon address on page 476 of the July, 1955, issue of The Review. Methods by which the Institute's facilities for training students in various fields may be brought more nearly into conformity with the student's choice of professional course also forms a part of the President's Report; this topic received attention at the Alumni Officers' Conference reported on page 22 of this issue.

The President's Report recalled that the Institute has ample evidence of the excellence of its student body, but President Killian offered several proposals for the continuation and augmentation of its program. Said Dr. Killian:

Of course we have always given priority to quality, but I suggest that we have a special responsibility now to make sure that we achieve here in Cambridge a high watermark of American intellectual and cultural life. Specifically, I propose that we continue and augment our efforts to:

1: Maintain those conditions of atmosphere, freedom, and creative opportunity which make our institution a place of superior attraction and environment for first-rate minds. M.I.T. should be known to be, and actually must be, one of the most attractive places in the world in terms of its success in creating and maintaining an environment benign to fruitful teaching, learning, and research. Such an environment is characterized by many subtle qualities:

(Concluded on page 68)

ONE of the designs by Samuel Chamberlain'18 for the M.I.T. Wedgwood dinner-service plates. . . . Orders in sets of eight should be placed with the Alumni Office, Room 1-280, M.I.T., Cambridge 39, Mass., for delivery prepaid in the U.S.A. or Canada at the following prices:

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PRESIDENT'S REPORT

(Concluded from page 67)

the standards of excellence which prevail, the interaction and interstimulus of first-rate minds gathered together, the emphases on growth, advance, and creativity in the fields embraced, the status of dignity and freedom the members of the community of scholars have and *feel* they have. These are the qualities which Milton once so eloquently described as a spirited, cheerful, searching, innovating "passion for thought" dedicated "to the search and expectation of greatest and exactest things."

2: Maintain those conditions of compensation, recognition, and reward which will best serve the environmental ideals which I have just described. Today our most pressing need is for an increased staff salary scale.

3: Maintain our standards for selection and promotion high enough to insure an unexcelled Faculty. In promotion we should always give priority to our own people, provided they are as good as anyone who might be found available elsewhere. We should check our own standards of selection against the highest in other institutions, and in filling vacancies we should seek the best men available anywhere in the world.

4: Apply comparably high standards to the selection of students. Present selectivity is good, but we still wind up with a "lower third" of each class which is not up to the standards of excellence we are discussing here. The achievement of the selectivity here proposed should take precedence over the admission of larger classes. The fact that we now admit a higher percentage of our students from foreign countries (11 per cent) than any American college gives us an incomparable opportunity to check our student quality against the cream of the world crop. . . .

Two problems in particular are designated in the President's Report for study by the Institute's governing body. These are (1) the encouragement of more autonomy and individuality on the part of each of the Institute's five schools, and (2) development of better exchange among professors in related fields but residing in different departments or schools.

President Killian's report presented a comprehensive review of major events and activities which took place in the M.I.T. community during the past year. These impressive high-level accomplishments are omitted here since most of these matters have already been presented in the pages of The Review for Volume 57.

What may well be regarded as the summary or concluding remarks of President Killian's annual report is in the paragraph reading:

Back of all of this discussion of excellence and of ways to improve our selectivity, our environment, and our program lies the assurance of an institution which has the poise and the self-confidence to look at itself critically and objectively. We can examine our needs and our requirements for augmented strength with a deep sense of self-confidence arising out of the knowledge that the Institute is in a flourishing state, that it has unexcelled standards, that its schools are strong and growing stronger, and that it has a team of Corporation, Faculty, Staff, students, and administration working together with great effectiveness and understanding. Herein lies the opportunity and the responsibility to seek the new standards I advocate. In so seeking lies our best response to the manpower needs of our country today in science and engineering.

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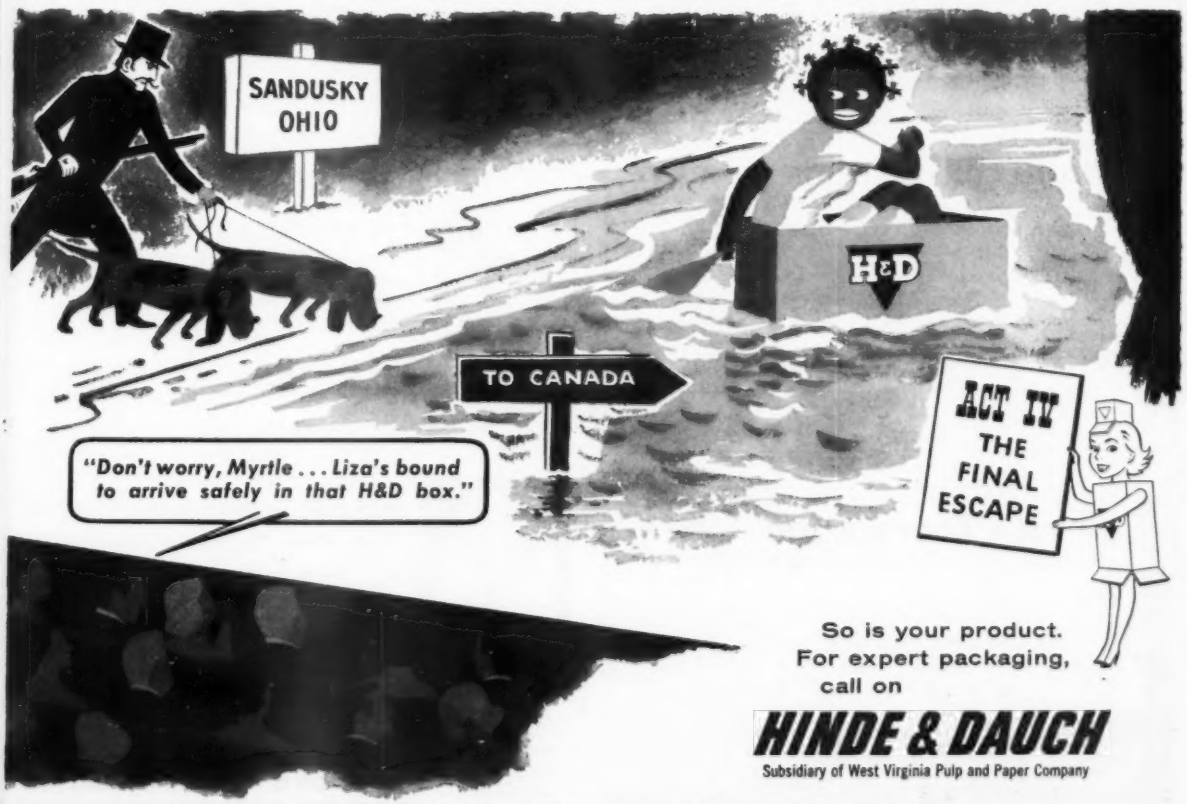

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EVALUATION OF STUDENT GOVERNMENT

(Concluded from page 32)

But enough of the past and present. What of the future? We are on the threshold of a new era in American Higher education. President Eisenhower's White House Conference on Education this fall will spell out more clearly the handwriting on the wall. Serious shortages in teaching personnel and facilities will become even more acute as record numbers of students crowd our primary and secondary schools and our institutions of higher learning. College enrollment alone promises to double within a decade or two. Yesterday George R. Harrison, Dean of the School of Science, gave you a picture of growing pains facing the Institute, when he spoke, in the Kresge Auditorium, at this Alumni Officers' Conference on "Problems of Growth at M.I.T."

At present the average American worker cannot afford to send more than one child to college. Segregation deprives many more of an opportunity for higher education. The waste of potential college material is appalling. Adult minds are working to solve these problems. A successful solution will mean a period of academic prosperity the like of which our country has never seen: The failure will mean a period of academic depression and decay.

The challenge is a great one. It doesn't stop at the state schools and universities. It is one that each of us, as a member of an educational community – in our case M.I.T. – must face. Student government must and will assume its position of responsibility alongside the Administration, Faculty, Corporation, and Alumni. I trust that we shall not fail.

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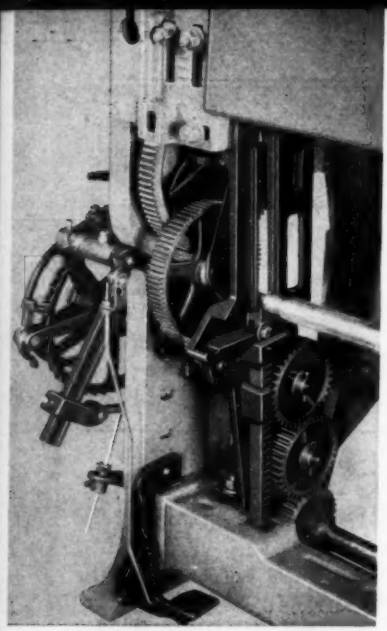

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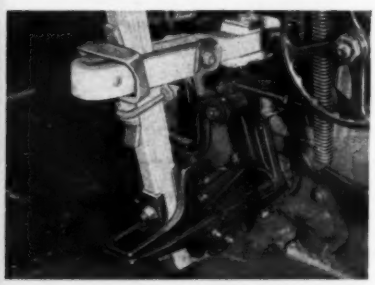

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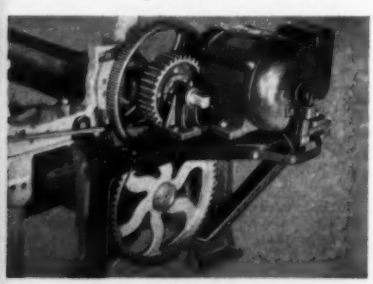

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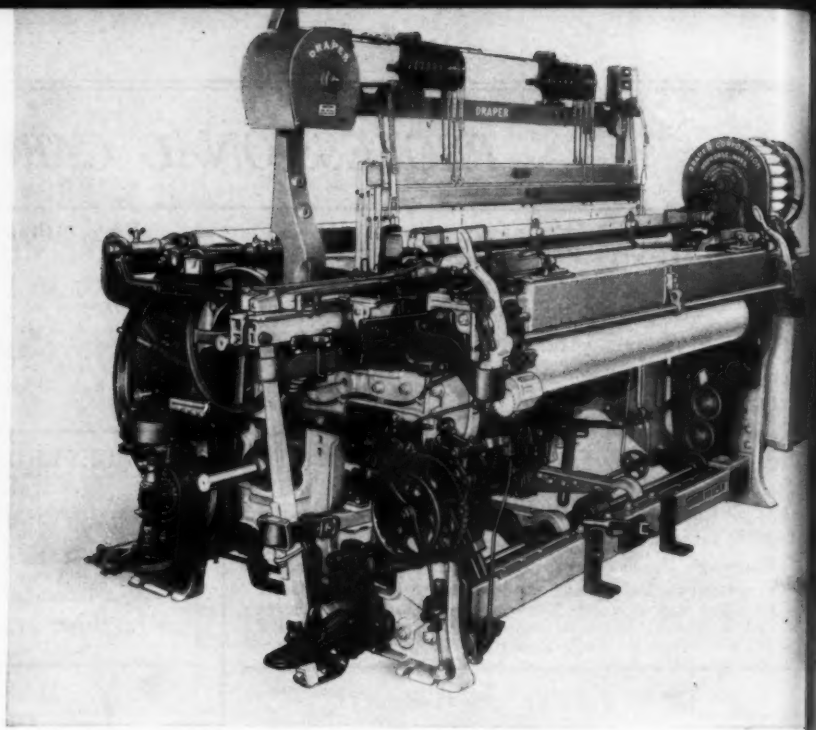

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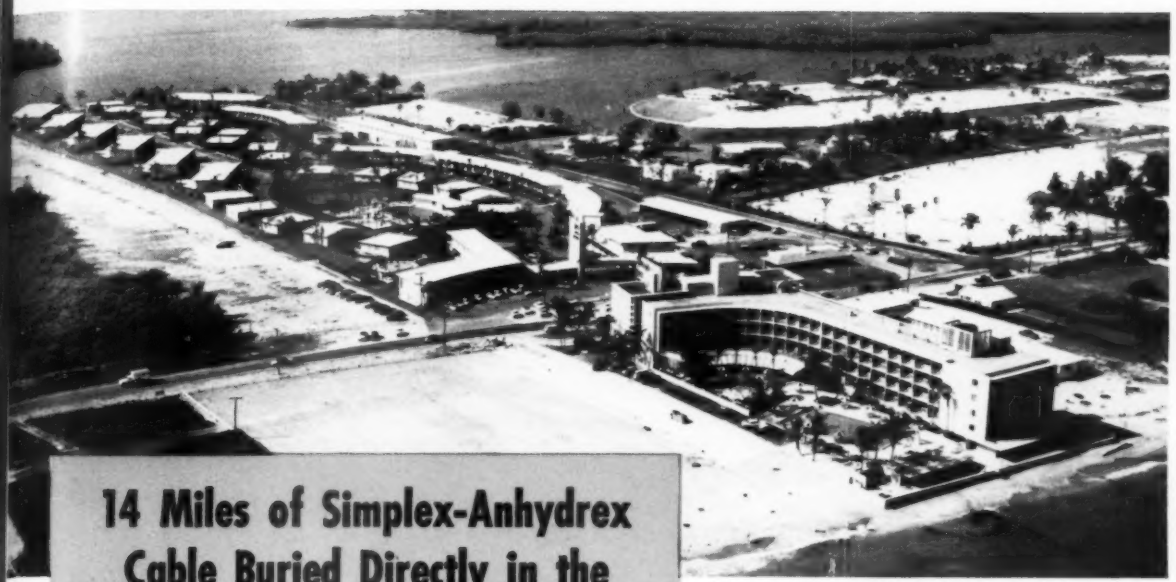

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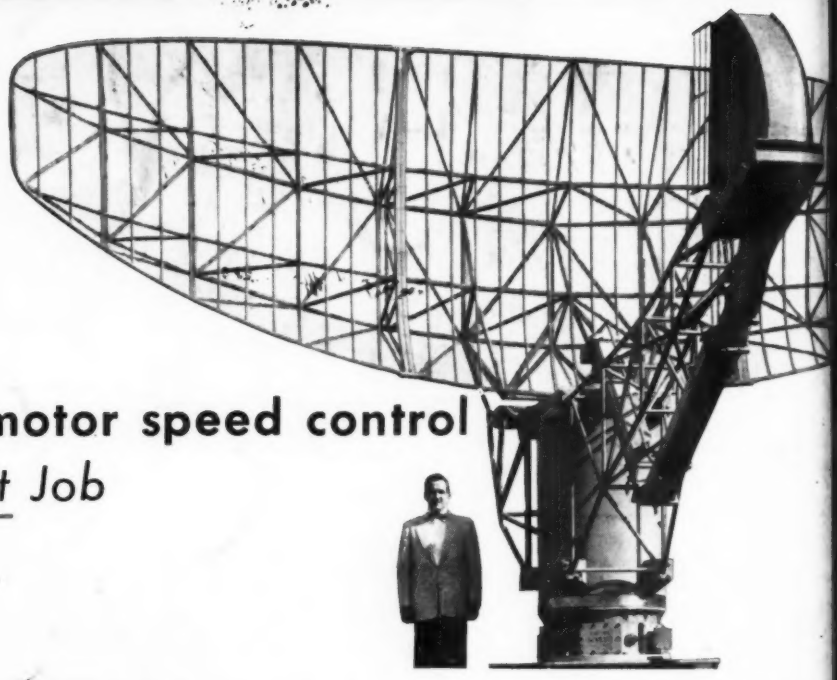

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